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USAF HISTORICAL STUDY NO. 180

PROBLEMS OF LONG-RANGE ALL-WEATHER INTRUDER AIRCRAFT

JUNE 1954

PREPARED BY THE USAF HISTORICAL DIVISION
THROUGH THE COOPERATION OF THE HISTORICAL DIVISION, HEADQUARTERS USAREUR

DEPARTMENT OF THE AIR FORCE

USAF HISTORICAL STUDY NO. 180

PROBLEMS OF
LONG-RANGE, ALL-WEATHER INTRUDER AIRCRAFT

Prepared by

P.R.C.

JOSEF KAMMHUBER
General der Flieger, a.D.

FOR AND UNDER THE SUPERVISION OF

THE USAF HISTORICAL DIVISION

WITH THE COOPERATION OF THE HISTORICAL DIVISION, HEADQUARTERS USAREUR

June 1954

DEPARTMENT OF THE AIR FORCE

FOREWORD

If an event is to be honestly told it is necessary to have evidence bearing on all aspects of the story. Where human conflict is involved, be it a dispute over an automobile collision at a street corner or a war among the nations of the World, it becomes even more necessary to have facts bearing on both sides of the story. It is not enough to have a large amount of evidence if it is limited to that provided by but one party to the conflict. Thus, the avalanche of reports, diaries, memoirs, and histories detailing the day-by-day happenings of World War II which has descended upon library and home has simply recreated an old problem for the historian, for up to this time the avalanche has been almost wholly Anglo-American. The story of World War II cannot be accurately or fully told until the testimony and evidence of the other party--the Axis Powers--has been made available.

It is a truism of history as well as of human psychology that the lessons of war are more forcibly impressed upon the vanquished than upon the victor. Success in war, as in every human activity, fosters satisfaction with the means by which it was gained. The victor tends to contemplate the future securely confident of the methods and means which won him the past conflict. Successful developments and innovations in the science and arsenal of war have been adopted or conceived almost invariably in the disillusionments and questionings of defeat, seldom in the complacencies of victory. Well might the U.S. Air Force join its former adversary, the German Air Force, in studying the lessons to

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be learned from his defeat, if it would defend itself against the dangers inherent in this truism.

A sobering dilemma faces the Air Force. The one nation in the World about which it needs to know the most is the one nation about which it knows the least. Yet, all of its planning, training, and building are aimed at a capability which will deter or defeat aggression by this same one nation. It cannot, of course, ignore any means by which information vital to this goal might be obtained. And only the former leaders of the German Air Force have first-hand knowledge, gained through long and bitter experience, of the combat and logistical problems posed by aerial conflict with this nation.

It was such considerations as these that moved Dr. Albert F. Simpson and Mr. Joseph W. Angell, Jr., Chief and Assistant Chief Historians, respectively, of the USAF to recommend in the Fall of 1952 that a project be established for an extensive series of studies of the German Air Force in World War II which would use former leaders of that air force as authors. This recommendation was concurred with in turn by Col. Wilfred J. Paul, Director of the Research Studies Institute, and Lt. Gen. I. H. Edwards, Commanding General of Air University, and approved by the Chief of Staff, USAF, on 26 November 1952.

The Department of the Army immediately volunteered to share with the Air Force the facilities, personnel, and know-how of its Historical Division, Headquarters USAREUR, which had conducted a similar project since the close of World War II. This generous offer was accepted, and Col. Wilbur S. Nye, Chief of the Division, and Lt. Col. Hans W. Helm, Chief of its

Foreign Military Studies Branch, shouldered the burden of initiating, staffing, and administering activities under the project. The tasks of monitoring the project for the Air Force and of publishing and distributing its studies were given to Air University. Lt. Col. Wendell A. Hammer was assigned to the Historical Division as USAF Project Officer.

The Project was modeled on the parallel Army program. Two former high-ranking officers of the GAF, General der Flieger Paul Deichmann and Generalleutnant Hermann Plocher agreed to serve, respectively, as Chief and Assistant Control Officers. They, in turn, undertook to secure as principal authors or "topic leaders" former officers of the GAF who, by World War II position and experience, were especially qualified to understand and to write on happenings associated with each of the thirty-nine topics approved for study. The success of this undertaking is attested by the names listed in Appendix A.

The topic leaders have been assisted in their studies by the Control Officers and, where necessary, by other former officers of the GAF. They have also been able to base their studies on a solid foundation of source materials, much of which has hitherto been either unavailable or unexploited. These materials have consisted in part of copies or microfilms of captured GAF documents held since the close of World War II at Air University. Of similar value to the topic leaders, and of even greater significance to the USAF and to the professional historian, however, have been a large number of documents and photographs retained since the war in one way or another by various officers of the GAF, and freely turned over to the

Project. It is quite probable that these latter source materials would never have been assembled in one collection had it not been for the Project, and for the initiative, professional stature, and untiring effort of the Chief Control Officer.

The authors of this and other studies prepared under the Project have had but limited access to information on the scientific and technological developments which have so altered the tools of aerial warfare since May 1945. Most of them have also been sealed off by the language barrier from the flood of American and British writings on World War II. Too, every effort has been made in the translating and editing of the studies to preserve the original content and intent of the authors. As a result, certain viewpoints or statements of fact may be noted by the reader which are at variance with prevailing informed opinion.

On the other hand, the same circumstances which have shielded the authors from new technological information and from other historical accounts of World War II, have freed them to focus directly and exclusively upon the events and implications of that conflict. It should not be forgotten that the authors are the same skilled professional military men who, out of the lessons of World War I, developed and directed a military force which completely surprised, and almost conquered, the western World. The reader, therefore, would do well to ponder carefully before accepting or rejecting what the authors have had to say, bearing in mind that the science of war is built upon concepts which at one time or another have been at variance with prevailing informed opinion.

PROJECT OFFICER'S PREFACE

The author of the study presented in this monograph is well qualified by experience to write on the problems of the long-range, all-weather intruder aircraft. For over three years, August 1940 to November 1943, General Kammhuber held primary responsibility for defending Germany against the ever-mounting night attack of the Allied air forces. It was in support of this defense that intruder aircraft played their first, and by far their most important, roles in World War II. The planning, testing, and development of their activities were tasks over which the author exercised direct supervision.

Historical aspects of this study have been based primarily upon the author's personal recollections and papers. The consequent sparcity of documentation does not, however, detract significantly from the study, which is essentially operational rather than historical in nature.

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Problems such as the one posed in this study require solutions on two levels. First, the tactical and strategic aspects of the problem must be examined; these may be determined by evaluating the purposes to be served, the principles to be followed, and the methods of defense. An examination of these three factors will determine the tactical and technical requirements which must be met by a long-range intruder aircraft designed for all-weather employment.

Secondly, the study must also deal with finding solutions to the technical requirements. It must give some indication as to whether, and to what extent, the tactical and technical requirements are technologically possible. It must point out the directions which must be followed in order to approach, if not immediately then at least step by step, the goal of complete fulfillment.

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With
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June 1954

DEPARTMENT OF THE AIR FORCE

PROBLEMS OF

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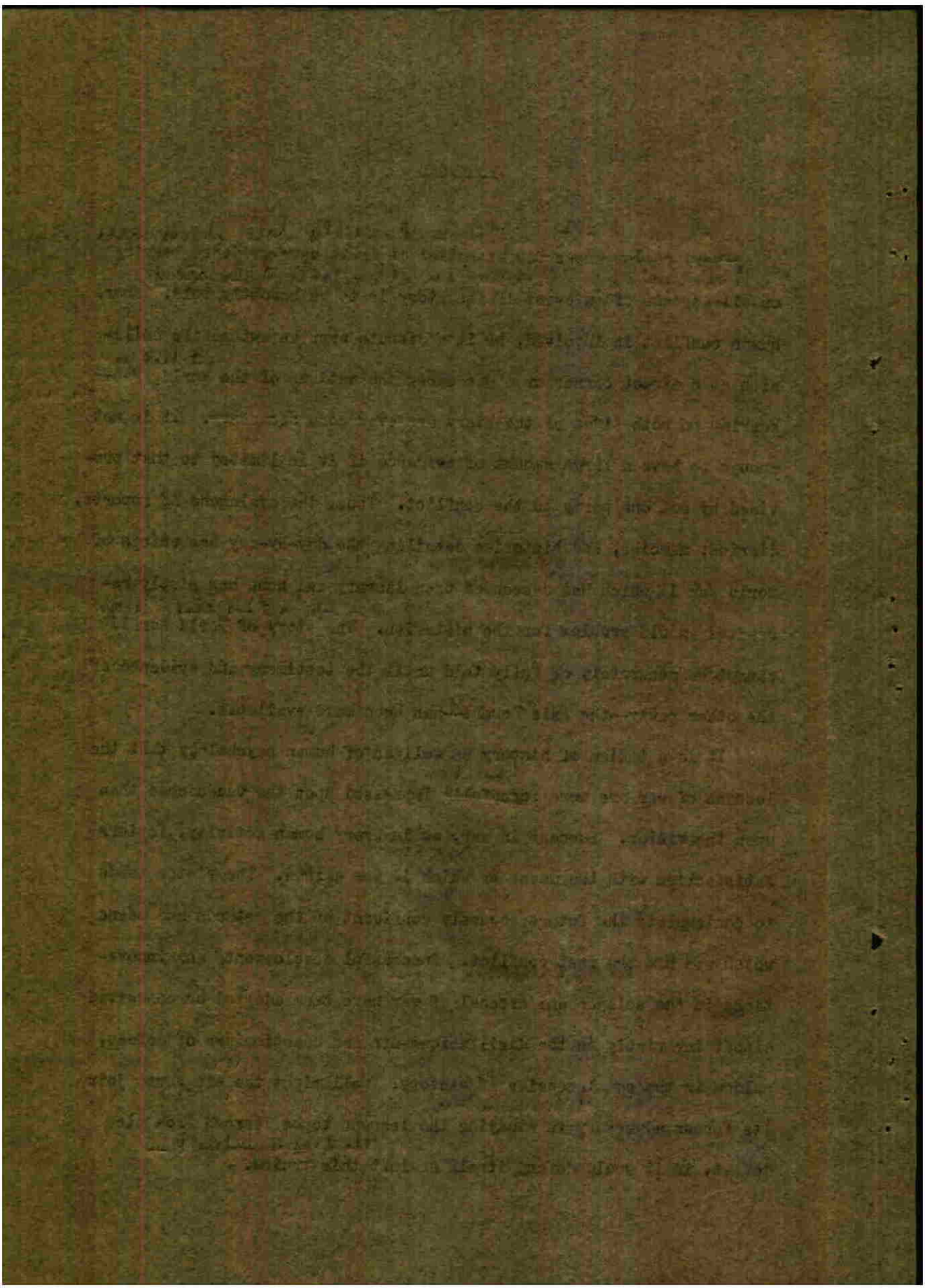

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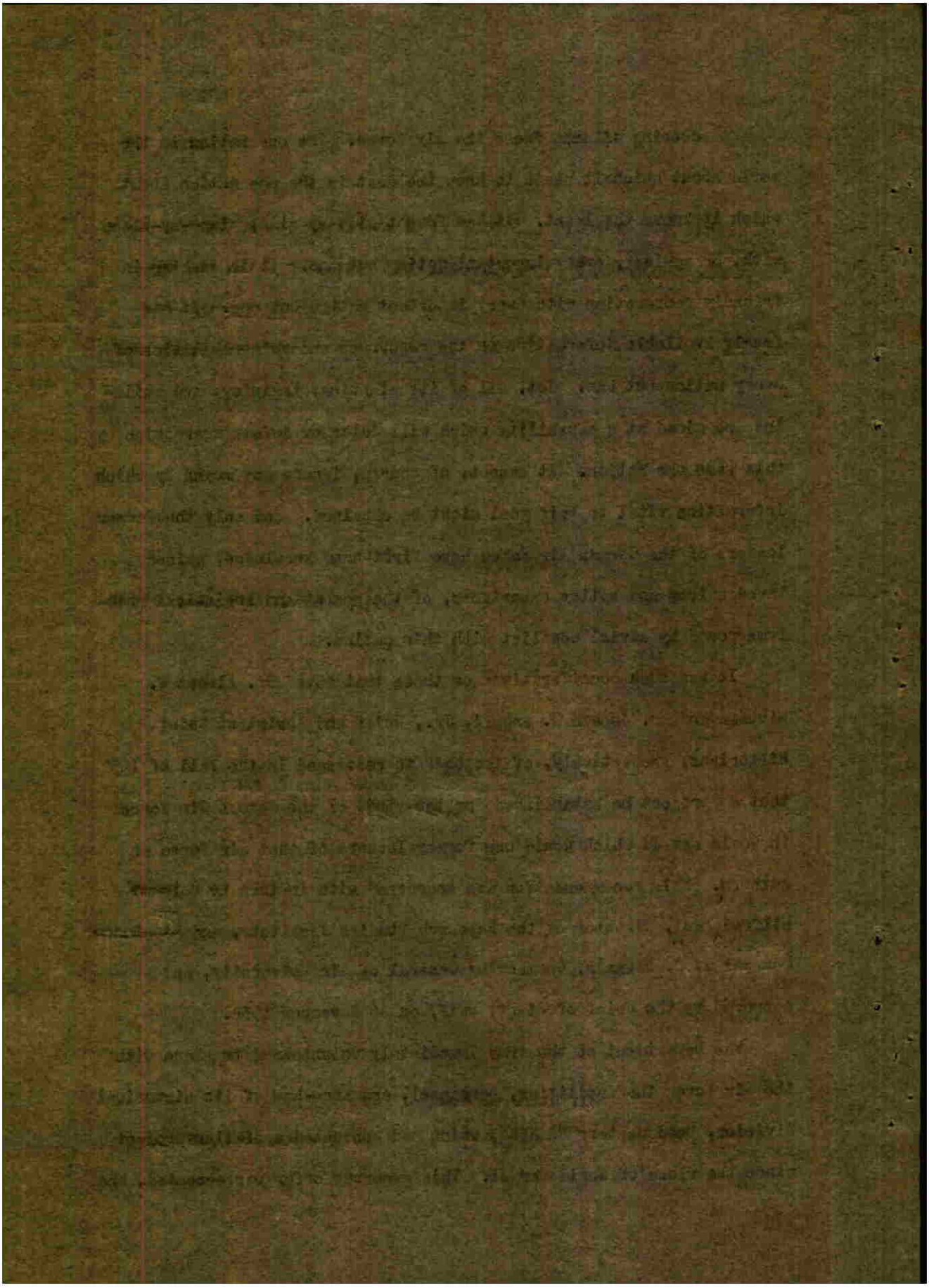

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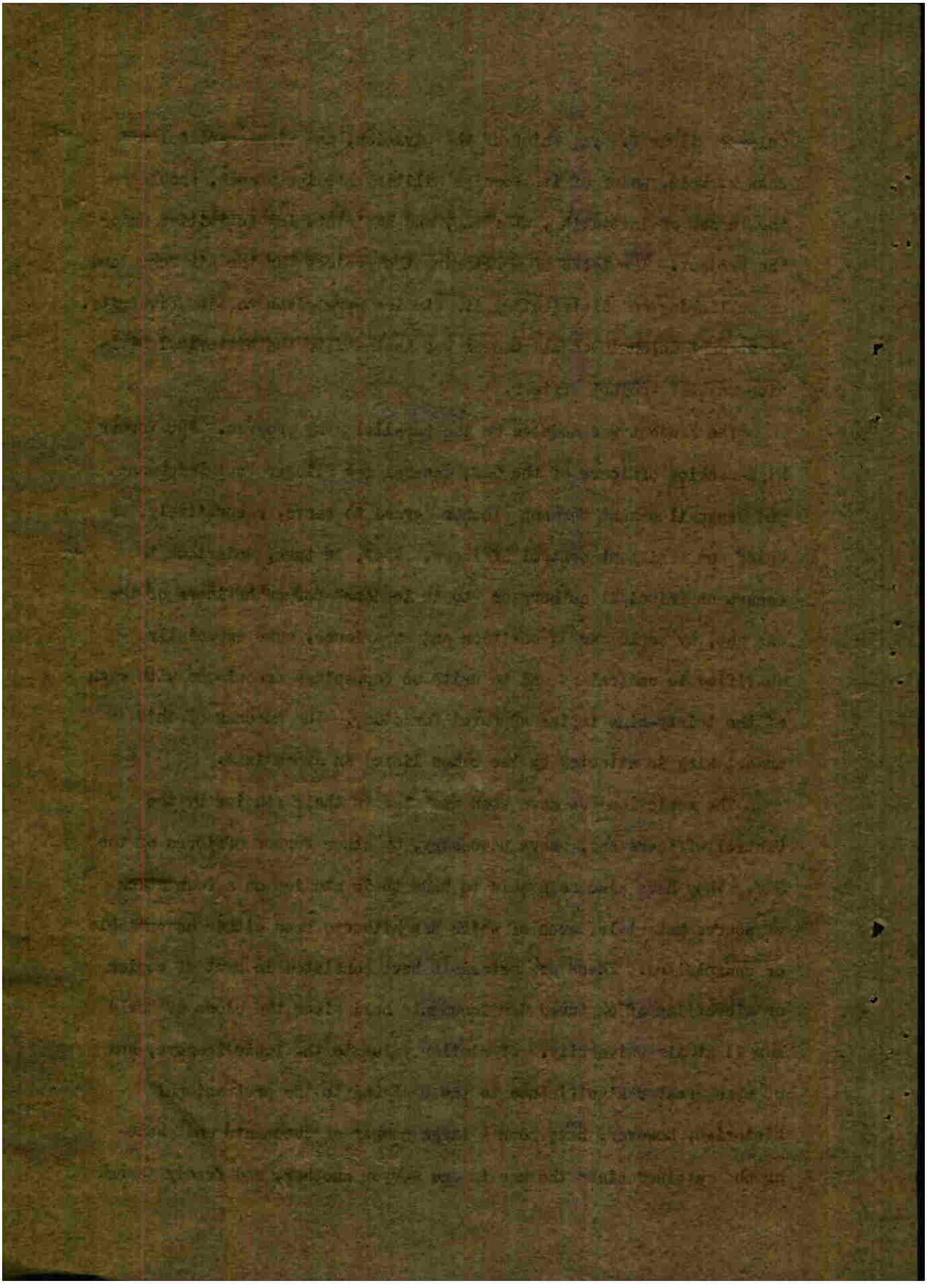

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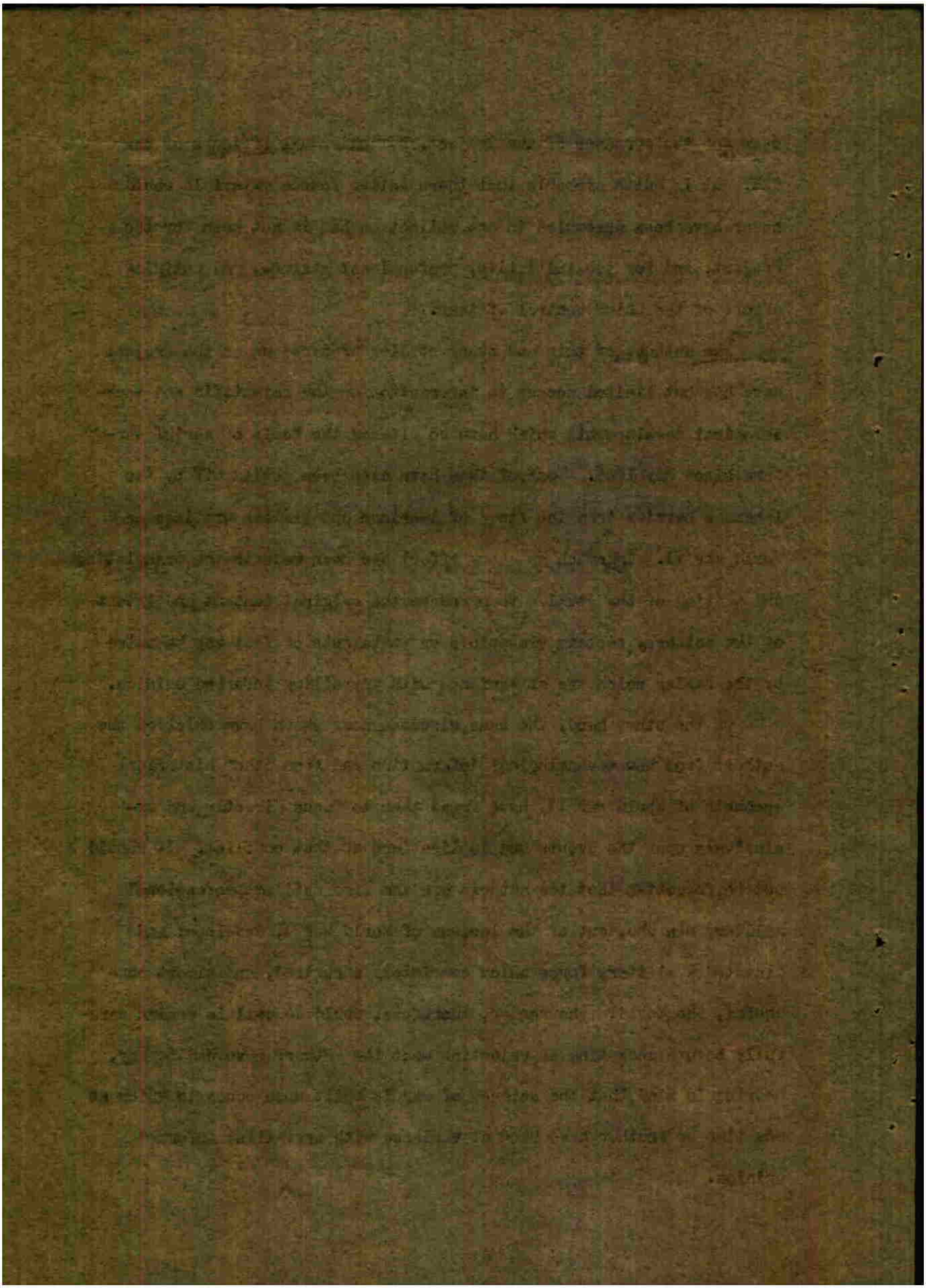

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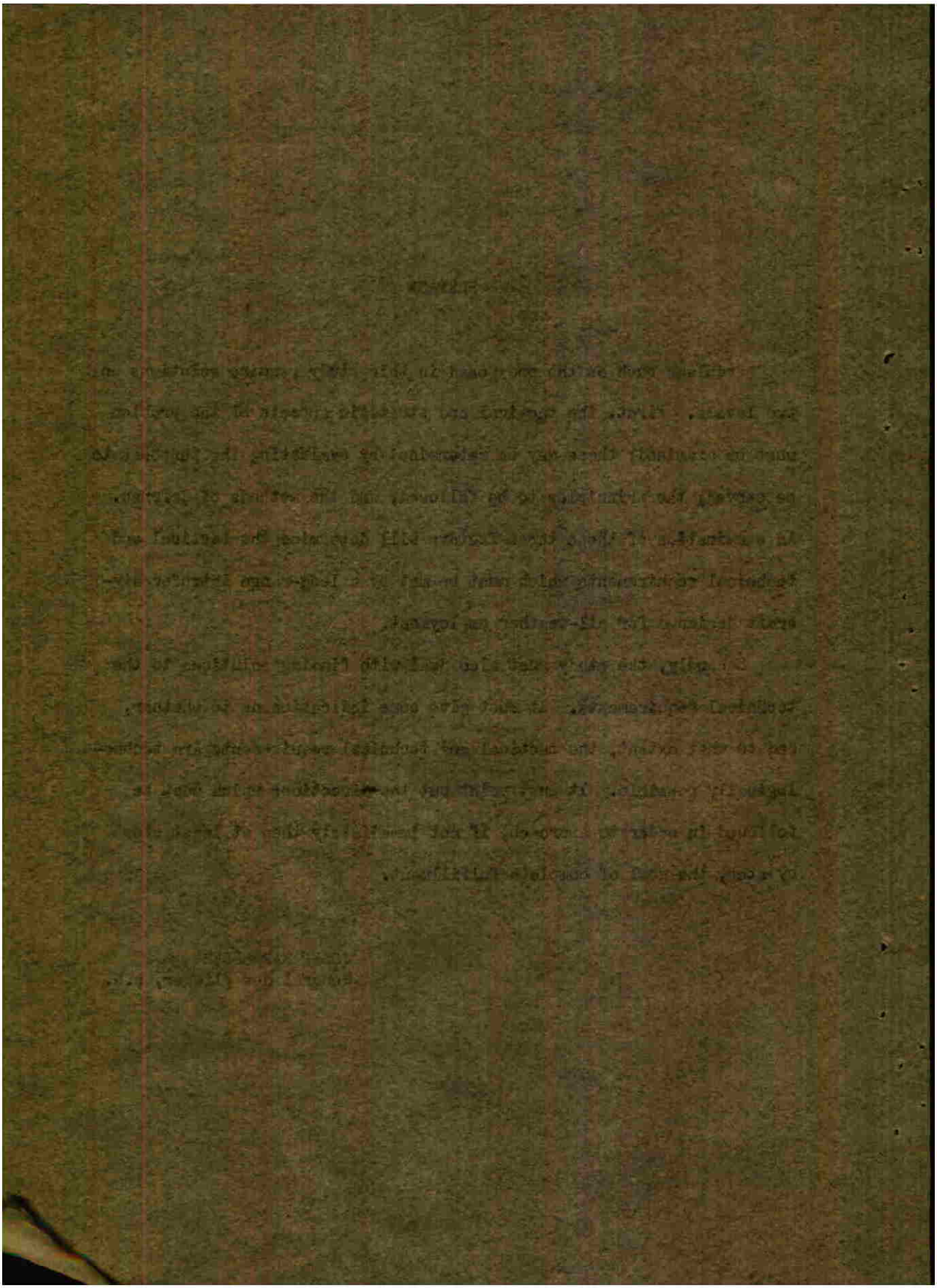
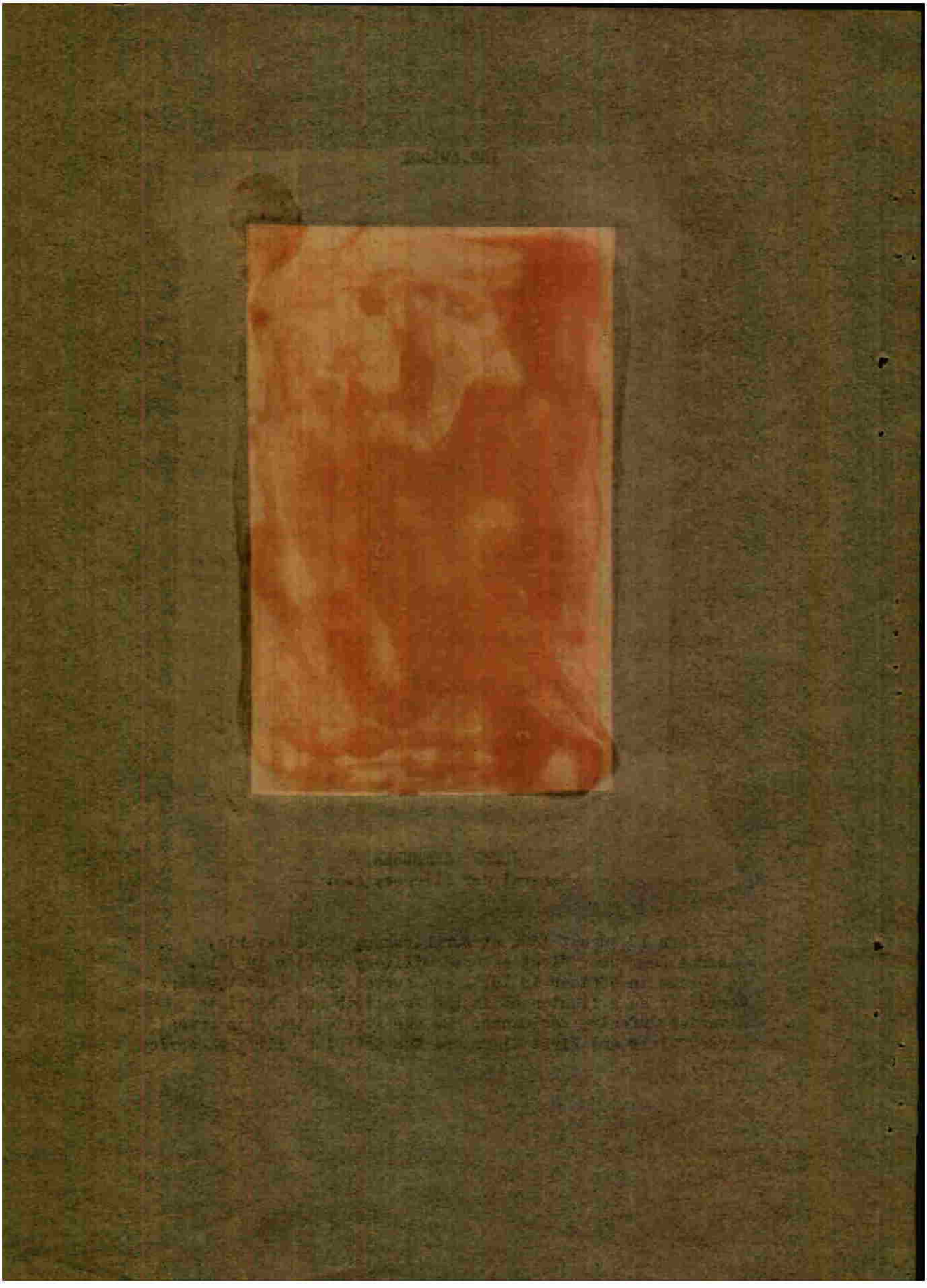


The Author

JOSEF KAMMHUBER
General der Flieger, a.D.

Born 19 August 1896 at Burgkirchen, Upper Bavaria, General Kammhuber first entered military service in 1914. He became an officer in 1915, and served throughout the first World War as a lieutenant in the Twentieth and Thirtieth Bavarian Infantry Regiments. He was awarded the Iron Cross Second Class and First Class and the Bavarian Military Service Medal.



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After World War I, his important assignments included three years of General Staff training, followed in 1930 by six years equally divided between the German Defense and Air Ministries. In 1936 he was given command of a fighter group, and one year later was made Chief of the Organizational Staff of the Air Ministry, a position which he held until 1 February 1939.

General Kammhuber, at the beginning of World War II, was Chief of Staff of the Second Air Fleet. Soon after receiving command of the 51st Bomber Wing he was shot down near Paris, and for the next twenty-seven days was held as a prisoner of war. Following his release on 30 June 1940 by the victorious German forces, he was given command of the 1st Night Fighter Division. He was promoted to Commanding General of the XII Air Corps (night fighter) in August 1941, a position which he held concurrently as commander of all night fighter activities until he was transferred to Norway in November 1943 as commander of the Fifth Air Fleet. One year later, October 1944, he was brought back to Germany as officer in charge of the jet-propelled aircraft program. His military citations during World War II included two bars to each of his previously awarded Iron Crosses, the Knight's Cross of the Iron Cross, the Combat Aviation Clasp, and various decorations from other Axis nations.

General Kammhuber was held as an American-British prisoner of war until 22 December 1947. (His present address is Schwindstrasse 24/IV, Munich 13, Germany.)

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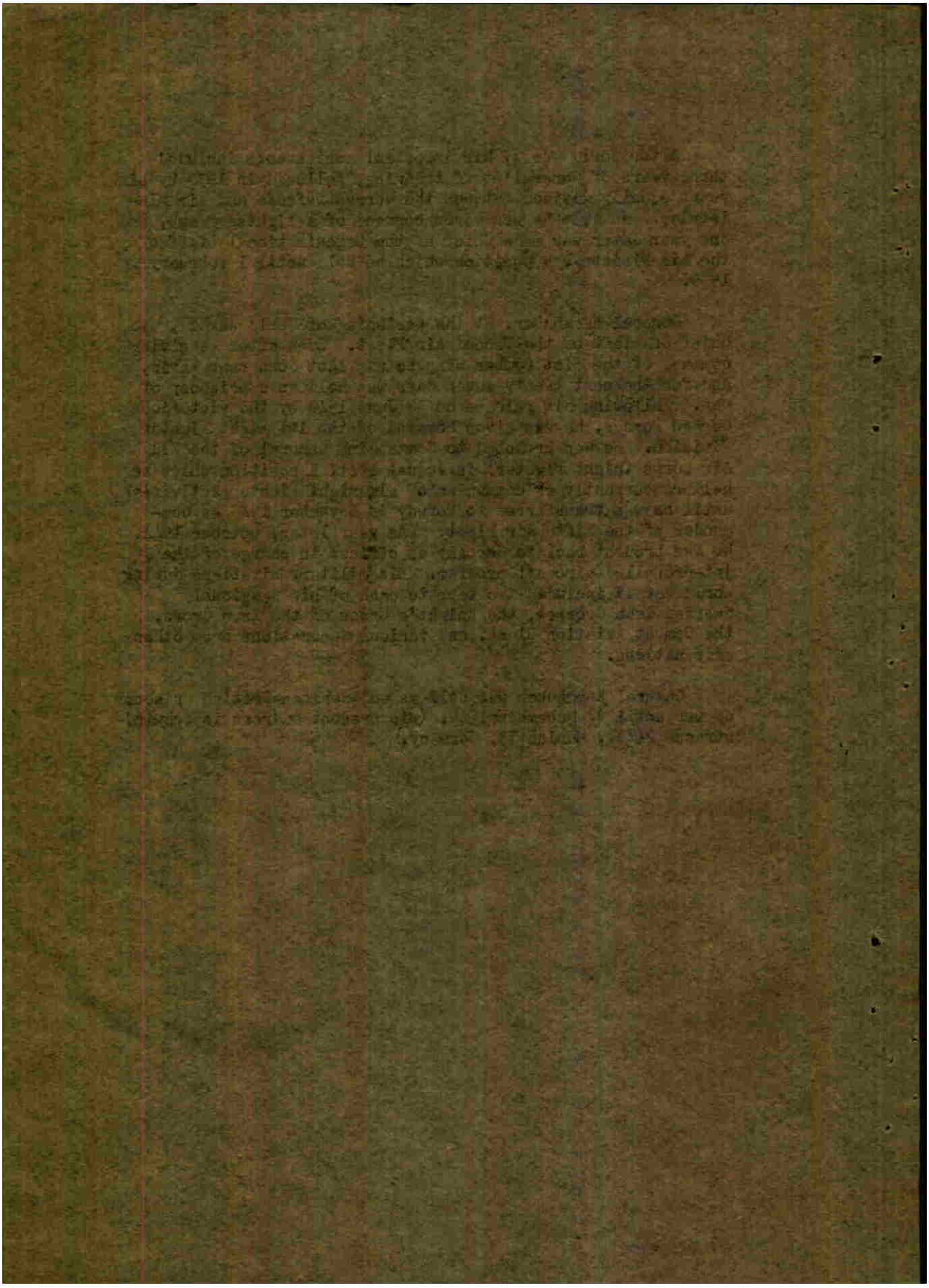

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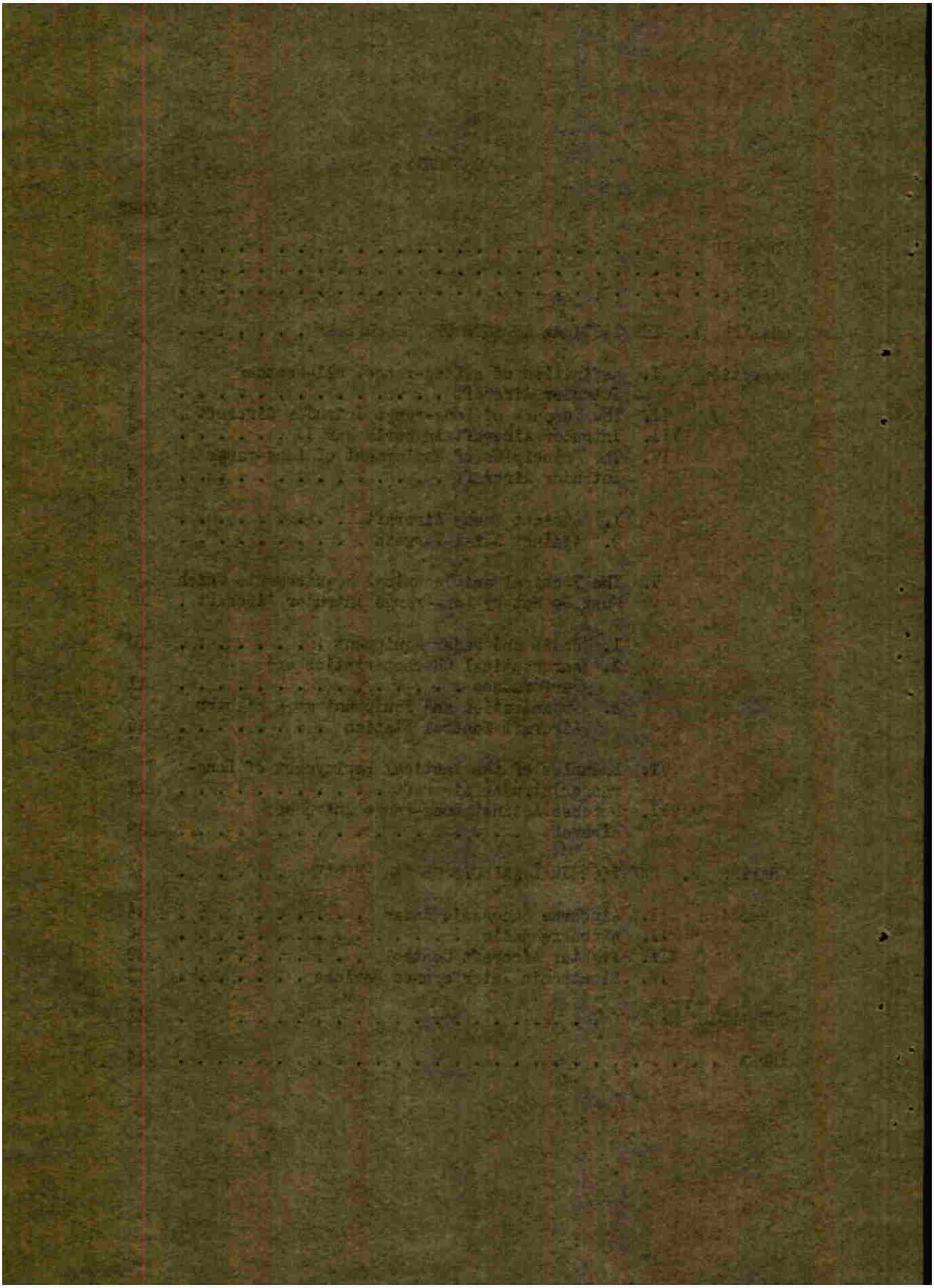

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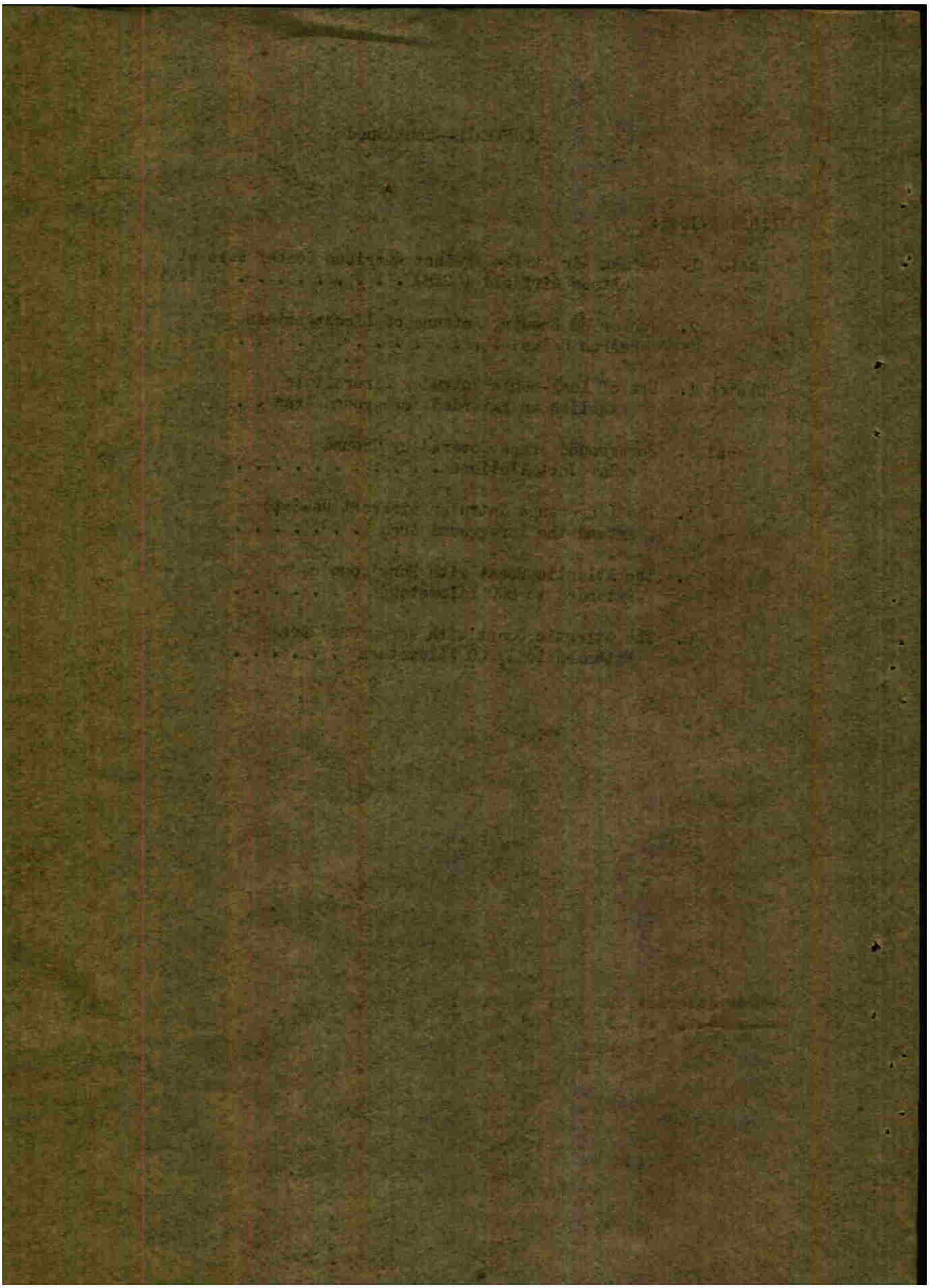

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CHAPTER 1

THE TACTICAL ASPECTS OF THE PROBLEM

I. DEFINITION OF A LONG-RANGE, ALL-WEATHER INTRUDER AIRCRAFT

An "intruder" aircraft[1] is actually a "shadowing airplane." The necessity for maintaining contact and shadowing arises when a moving enemy target cannot be picked up by ground radar. This situation may result from any one of several factors: the target may not yet have come into ground radar range or it may already have passed beyond range; the radar equipment may have been partially or wholly jammed by the enemy, forced to drop out of action, or unable to produce a clear picture of aerial activity.

In this particular study, as is indicated in the term "long-range, all-weather intruder aircraft," the first of the factors mentioned above will be dealt with, that is, the intruder airplane will operate beyond

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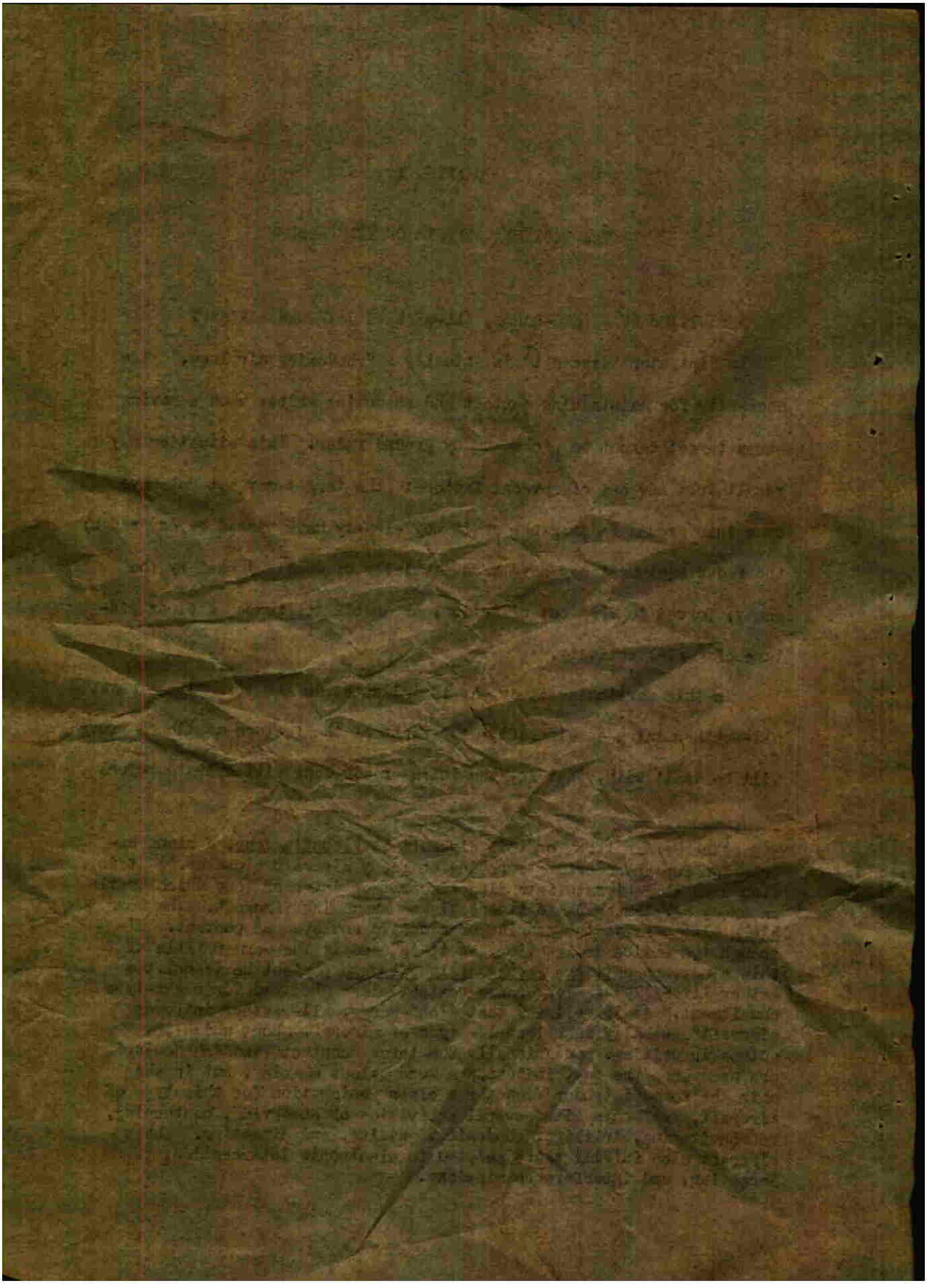
[1] The German term for this aircraft is Klebeflugzeug, a slang expression for an aircraft "pursuing an enemy aircraft close up." It is also used to designate intruding aircraft or intruder (one which trails an enemy airplane back to its base) and shadowing aircraft. The word Kleb- also conveys the meaning of adhesive and even of contact. Although the entire designation, as it is used in the German title of this study, nächtliche Fernkampfklebeflugzeuge might be translated rather literally as "long-range contact plane designed for night-type commitment," it is believed that "long-range, all-weather intruder aircraft" actually describes the type of aircraft about which the author is writing. Occasionally the terms "contact" and "shadowing" are used when the text indicates a more select meaning, but in the main the term "intruder" denotes a class designation for this type of aircraft, performing its several activities of observing, contacting, reconnoitering, trailing, shadowing, guiding, and directing. These aircraft also fulfill tasks related to electronic interception, deception, and interference missions.



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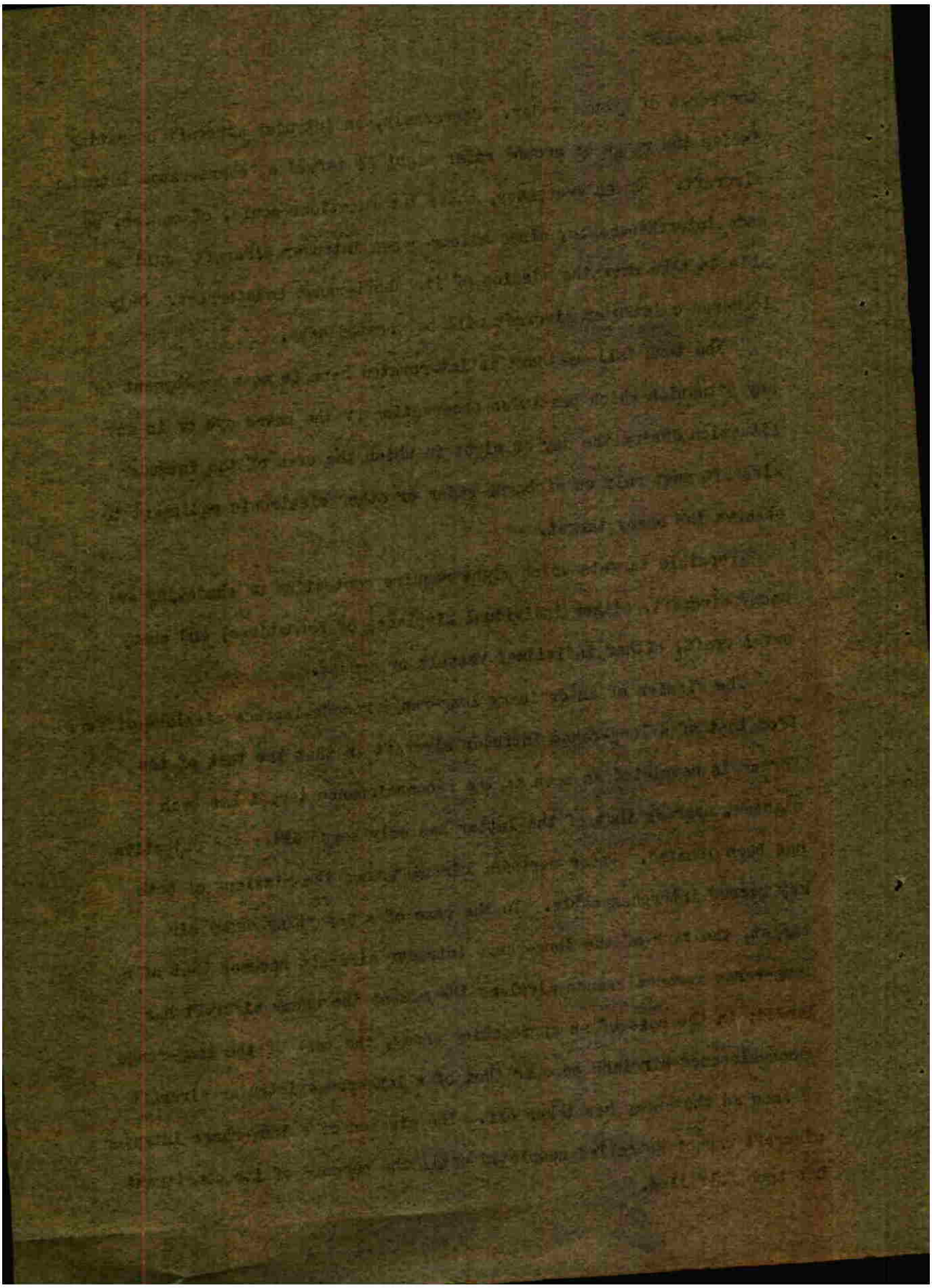
the range of ground radar. Conversely, an intruder aircraft operating within inside the range of ground radar might be termed a "short-range intruder aircraft." In an emergency, these two functions could, of course, be made interchangeable, since a long-range intruder aircraft would be able to take over the mission of its short-range counterpart. Only long-range intruder aircraft will be treated here.

The term "all-weather" is interpreted here to mean employment in any situation which precludes observation by the naked eye or in any situation during the day or night in which the crew of the intruder aircraft must rely on airborne radar or other electronic equipment to observe the enemy target.

Possible targets which might require contacting or shadowing are enemy aircraft, either individual airplanes or formations, and enemy naval craft, either individual vessels or groups.

The mission of an ordinary long-range reconnaissance airplane differs from that of a long-range intruder aircraft in that the task of the former is completed as soon as the reconnaissance target has been sighted, whereas that of the latter has only begun after the objective has been located. Under certain circumstances the missions of both may become interchangeable. In the case of a departing enemy air target, the task of the long-range intruder aircraft becomes that of a long-range reconnaissance airplane the moment the enemy aircraft has landed; in the case of an approaching enemy, the task of the long-range reconnaissance airplane becomes that of a long-range intruder aircraft as soon as the enemy has taken off. The mission of a long-range intruder aircraft cannot be called completed until the purpose of its commitment has been fulfilled.



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II. THE PURPOSE OF LONG-RANGE INTRUDER AIRCRAFT

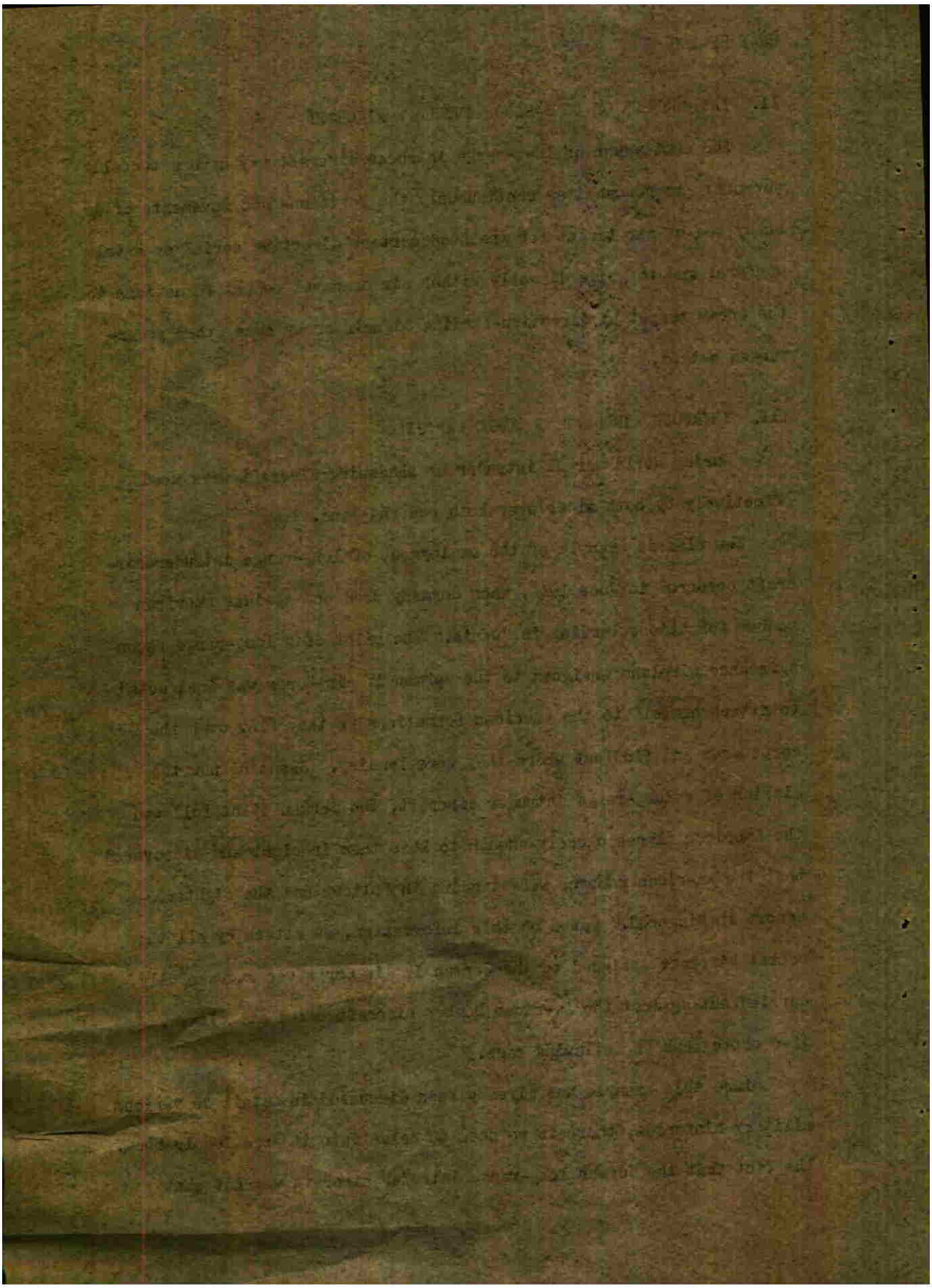
The employment of long-range intruder aircraft may have a twofold purpose: to reconnoiter continuously the positions and movements of an enemy sea or air target for the headquarters directing aerial or naval warfare; and to guide directly either air or naval combat formations to the enemy target by direction-finding signals or by some other prearranged method.

III. INTRUDER AIRCRAFT IN WORLD WAR II

During World War II intruder or shadowing aircraft were used effectively by both sides over both sea and land.

The classic example of the employment of long-range intruder aircraft occurred in June 1944, when Germany used one against American bomber formations landing in Russia. The pilot of a long-range reconnaissance airplane assigned to the German IV Air Corps was instructed to attach himself to the American formations as they flew over the corps area and find out where they were landing. Assuming now the mission of a long-range intruder aircraft, the German pilot followed the American planes closely enough to keep them in sight and discovered that the American bombers were landing in Poltawa and the fighter escort in Mirgorod. Based on this information, an attack by all the combat aircraft assigned to the German IV Air Corps was successfully carried out against the American bomber aircraft based at Poltawa. (See photograph on following page.)

Since this example has already been discussed in detail in various military histories, there is no need to delve into it more deeply here. The fact that the German long-range intruder aircraft was not shot



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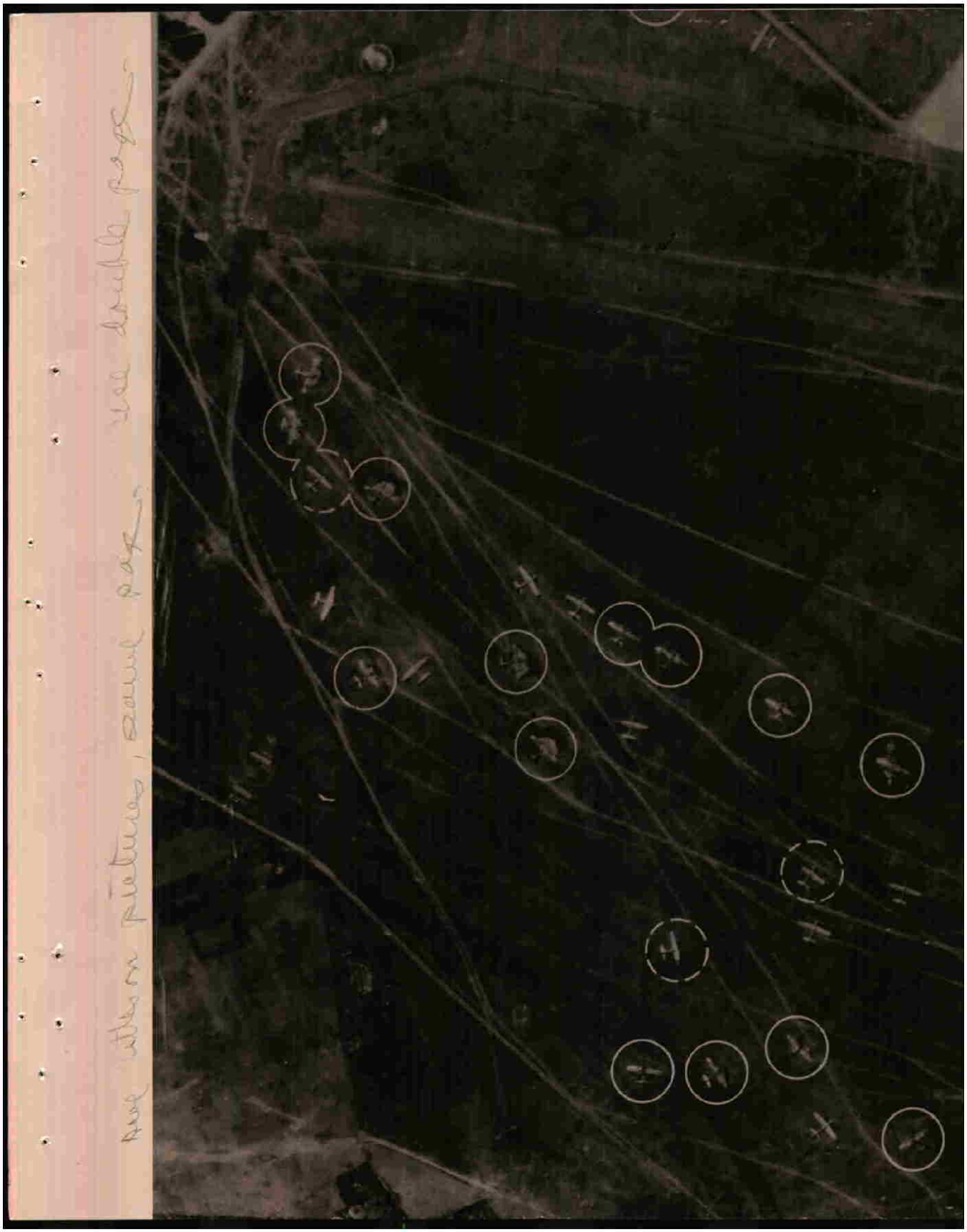

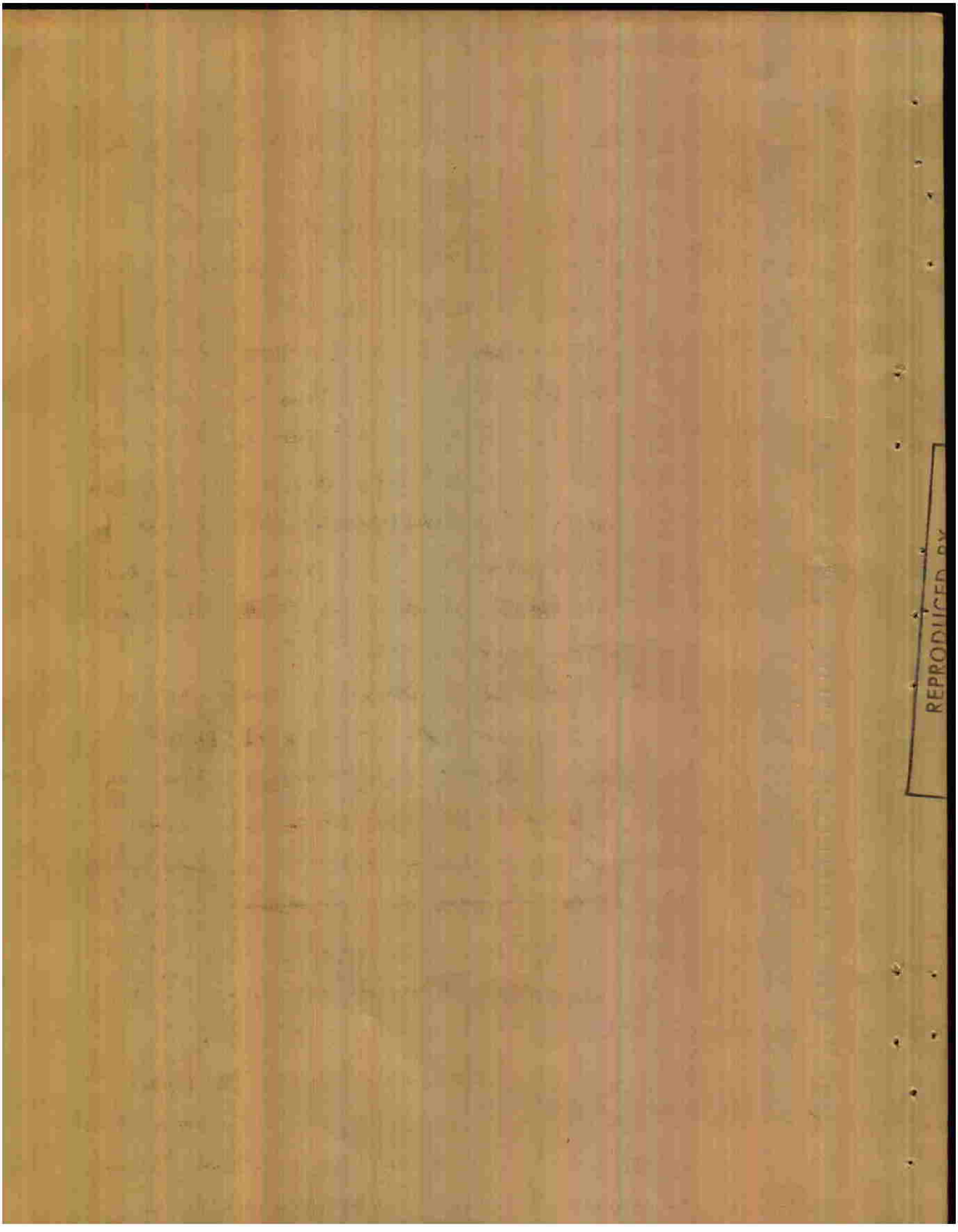

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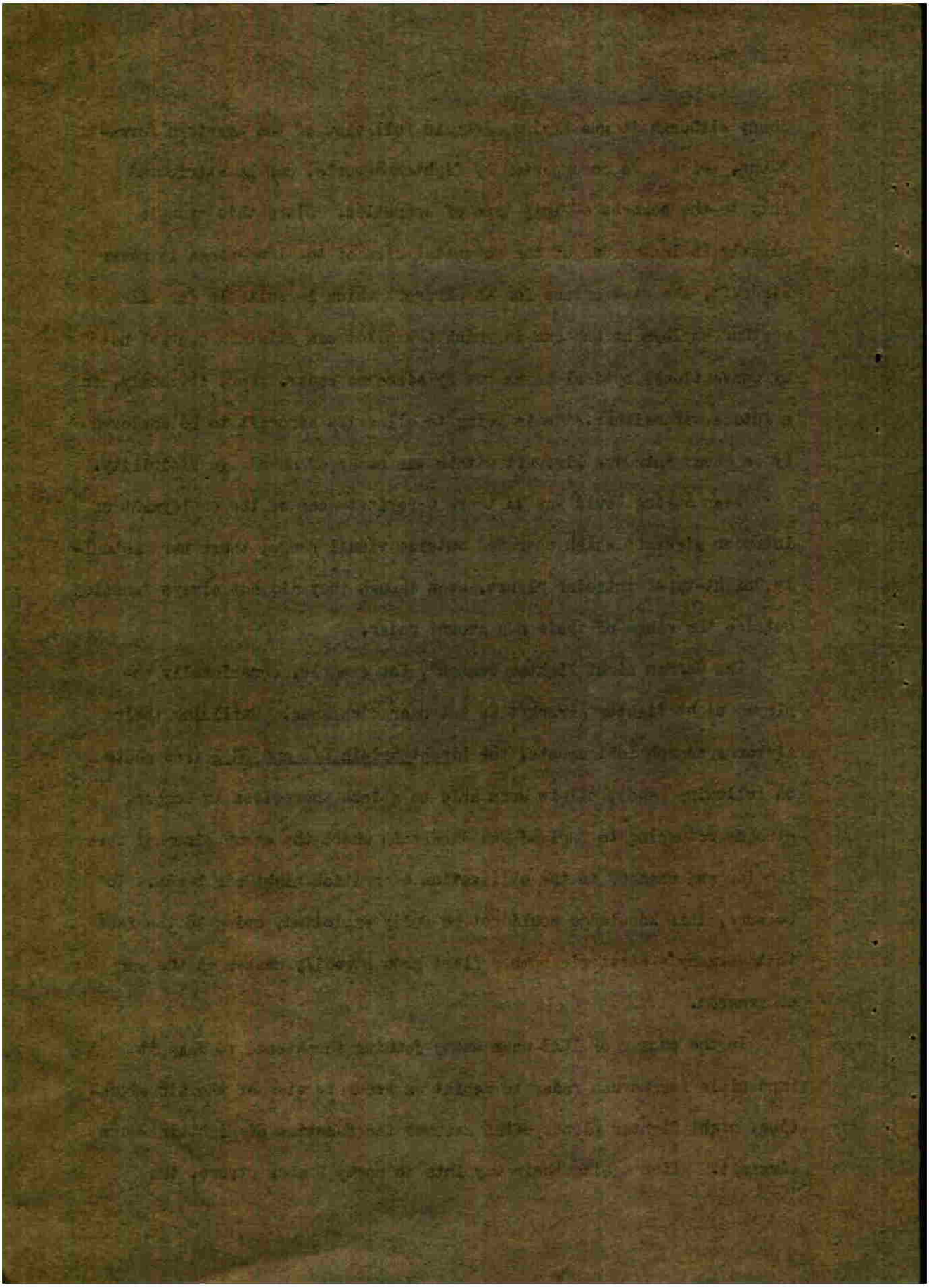
down, although it was flying along in full view of the American formations, which were accompanied by fighter escorts, can be attributed only to the newness of this type of operation. Since this example clearly indicates one of the potential uses of the long-range intruder aircraft, the need arises for an aircraft which is suitable for all-weather employment and one in which the pilot can maintain contact not by conventional optical means but by airborne radar. For, obviously, in a future war neither side is going to allow its aircraft to be shadowed by an enemy intruder aircraft within the range of naked eye visibility.

Even during World War II there were instances of the employment of intruder aircraft which operated outside visual range; these were actually "night-type" intruder planes, even though they did not always function outside the range of their own ground radar.

The German night fighter command, for example, occasionally employed night fighter aircraft as intruder airplanes. Utilizing their airborne search instruments, the Liechtenstein B/C and SN 2 (see photo on following page), pilots were able to attach themselves to bomber streams returning to England and ascertain where the enemy aircraft were landing and changes in the utilization of British night air bases. To be sure, this knowledge could not be fully exploited, owing to the fact that Germany's strategic bomber fleet grew steadily weaker as the war progressed.

In the summer of 1943 when enemy jamming threatened to make it impossible for German radar to depict an accurate view of the air situation, night fighter planes often assumed the function of night intruder aircraft. After making their way into an enemy bomber stream, the



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Junker 88 Showing Antenna of Liechtenstein Search Radar

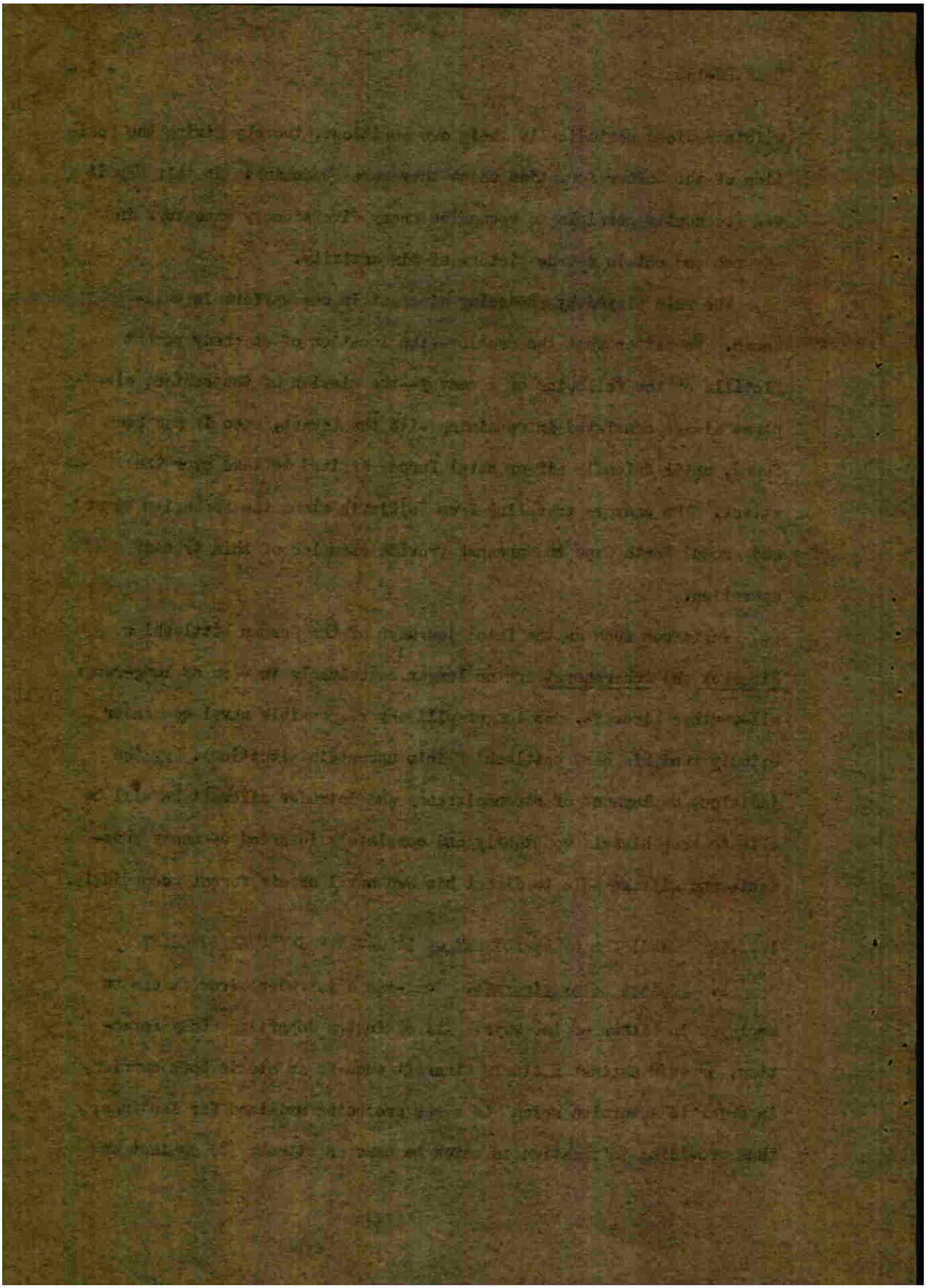
pilots radioed periodically their own positions, thereby giving the position of the bomber formation which they were shadowing. In this way it was frequently possible to recognize enemy diversionary maneuvers in advance and obtain a true picture of air activity.

The role played by shadowing aircraft in sea warfare is well-known. No matter what the problem--the location of an enemy combat flotilla or the following of a convoy--the mission of the contact airplane always consisted in remaining with the target, once it had been found, until friendly air or naval forces arrived to take over the attack. The convoys traveling from Rejkjavik along the Norwegian coast and around North Cape to Murmansk provide examples of this type of operation.

Instances such as the fatal journeys of the German battleships Bismarck and Scharnhorst are no longer conceivable in view of long-range all-weather aircraft. No longer will any responsible naval commander blindly send his best battleships into uncertain situations. By the judicious employment of reconnaissance and intruder aircraft he will be able to keep himself constantly and completely informed of enemy movements and will be able to direct his own naval or air forces accordingly.

IV. THE PRINCIPLES OF EMPLOYMENT OF LONG-RANGE INTRUDER AIRCRAFT

1. Against Enemy Aircraft. Long-range intruder aircraft can be employed in either of two ways: (1) against a departing enemy formation, or even against a single aircraft such as an atomic bomb carrier, in order to determine which air bases are being utilized for landings, thus providing information on which to base an attack; (2) against an



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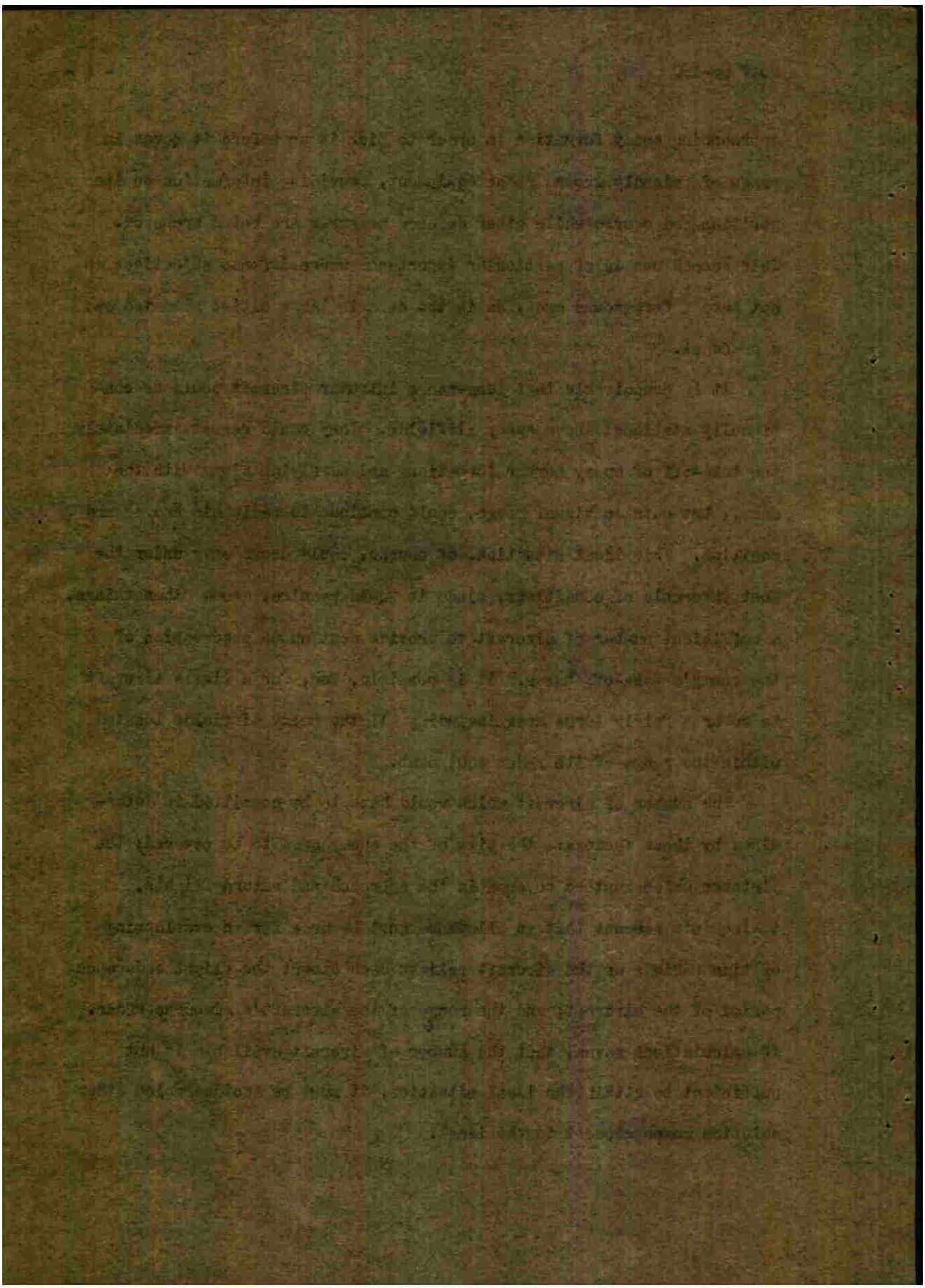
approaching enemy formation in order to pick it up before it comes in range of friendly ground radar equipment, providing information on its position and course while other defense measures are being prepared. This second use is of particular importance where defense objectives do not have a foreground area, as is the case in large cities situated on a seacoast.

It is conceivable that long-range intruder aircraft could be continually stationed above enemy airfields. They could report immediately the take-off of enemy bomber formations and by flying along with the enemy, but outside visual range, could continue to radio his course and position. This ideal situation, of course, could occur only under the most favorable of conditions, since it would require, among other things, a sufficient number of aircraft to provide continuous observation of the enemy's take-off bases. It is possible, too, for a single aircraft to cover a fairly large area including all the enemy airfields located within the range of its radar equipment.

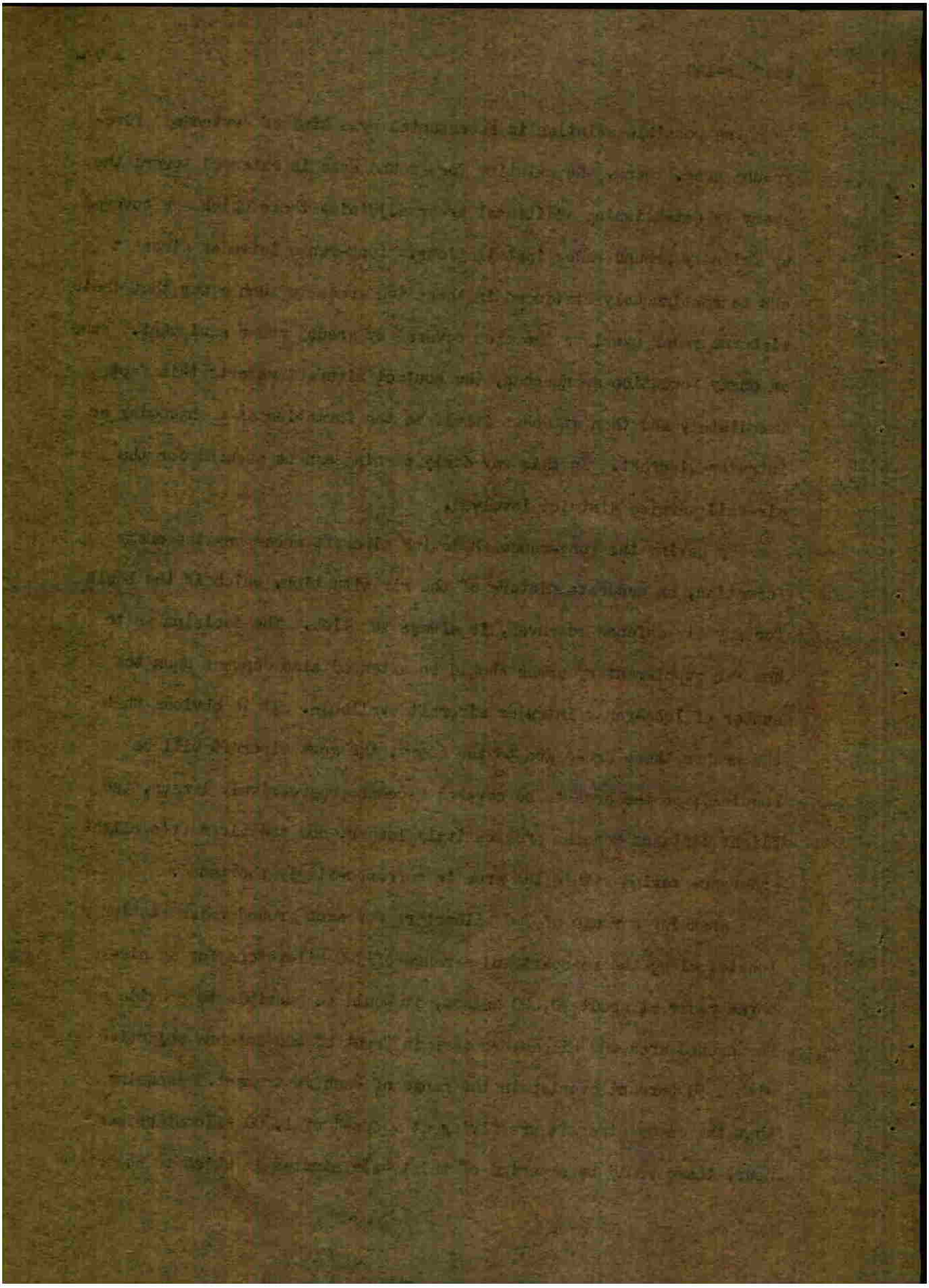
The number of aircraft which would have to be committed is determined by these factors: the size of the enemy area to be covered; the distance which must be covered in the approach and return flights, taking into account that an allowance must be made for an overlapping of time periods as the aircraft relieve each other; the flight endurance period of the aircraft; and the range of the aircraft's airborne radar. If calculations reveal that the number of aircraft available is not sufficient to attain the ideal situation, it must be decided which other solution comes closest to the ideal.



One possible solution is represented by a kind of "extended" foreground area. Here, the existing foreground area is extended toward the enemy by establishing additional areas adjoining those which are covered by friendly ground radar installations. Long-range intruder aircraft can be continuously stationed in these new areas in such a way that their airborne radar overlaps the area covered by ground radar equipment. When an enemy formation approaches, the contact aircraft reports this fact immediately and then attaches itself to the formation as a shadowing or intruder aircraft. In this way early warning can be assured for the air-raid warning district involved.

By having the long-range shadowing aircraft accompany the enemy formation, an accurate picture of the air situation, which is the basis for any air defense measures, is always supplied. The decision as to how far supplementary areas should be extended also depends upon the number of long-range intruder aircraft available. It is obvious that the nearer these areas are to the enemy, the more aircraft will be required; as the area to be covered becomes progressively larger, the flight distance becomes progressively longer, and the aircraft's flight endurance period within the area is correspondingly shortened.

Assuming a range of 300 kilometers for each ground radar station located along the seacoast and a range of 300 kilometers for an airborne radar at about 20,000 meters, it would be possible to provide a foreground area 600 kilometers deep in front of the defense objective with a 50 percent overlap in the range of each instrument. Assuming that the enemy aircraft are flying at a speed of 1,000 kilometers per hour, there would be a period of thirty-six minutes in which to undertake



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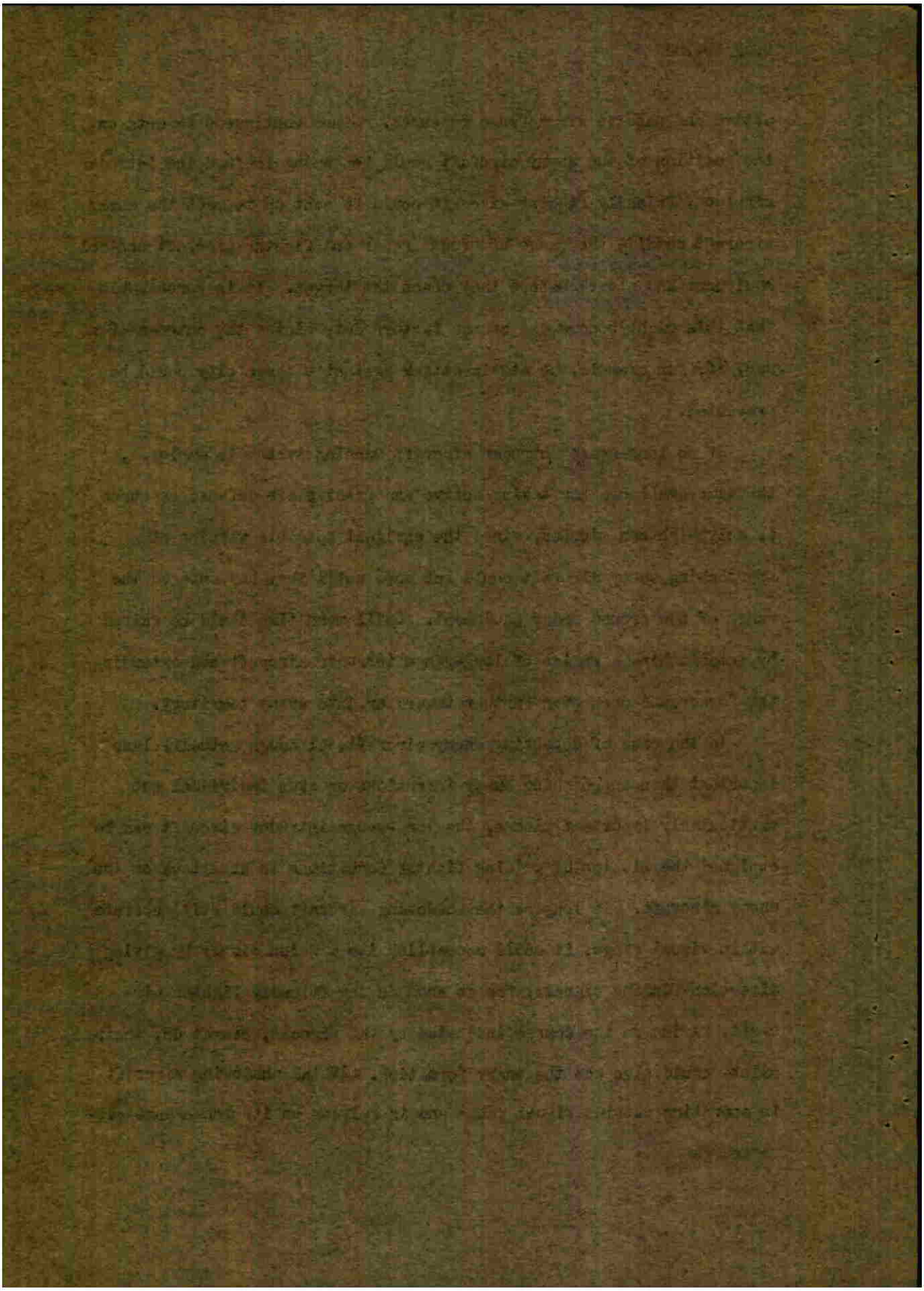
active and passive air defense measures. Since continuous reports on the position of the enemy aircraft would be coming in from the intruder airplane, friendly fighter aircraft could be sent up to meet the enemy aircraft outside the range of ground radar and fighter aircraft control equipment and attack before they reach the target. It is conceivable that this might become one of the factors determining the outcome of a war, if, for example, an atomic attack against a large city could be prevented.

If no long-range intruder aircraft warning system is employed, the time available for taking active and passive air defense measures is only eighteen minutes, since the earliest possible warning of approaching enemy aircraft could not come until they had entered the range of the ground radar equipment. Still more time could be gained by establishing a series of long-range intruder aircraft and extending the foreground area even further toward or into enemy territory.

In the case of departing enemy aircraft, although actually less important than approaching enemy formations or even individual but particularly important planes, the long-range intruder aircraft can be assigned the mission of guiding fighter formations to an attack on the enemy aircraft. As long as the shadowing aircraft could still operate within visual range, it could accomplish its mission simply by giving direction-finding signals; for as soon as the friendly fighter aircraft, flying on the course indicated by the signals, caught up, their pilots could also see the enemy formation. If the shadowing aircraft is operating outside visual range and is relying on its long-range



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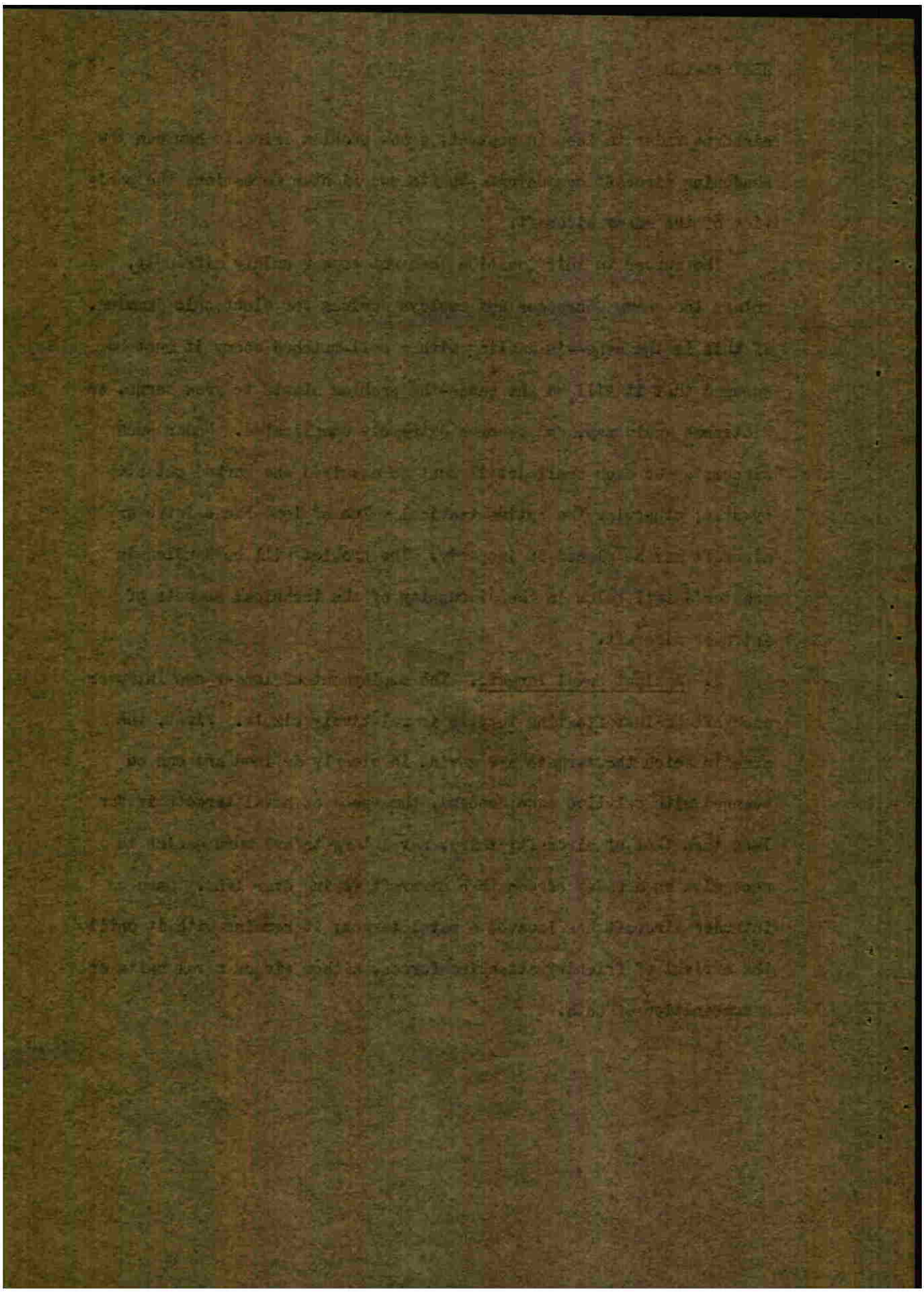
airborne radar to keep in contact, a new problem arises: how can the shadowing aircraft communicate to its own fighter formations the position of the enemy aircraft?

The answer to this question does not appear unduly difficult, unless the enemy possesses and employs devices for electronic jamming. If this is the case--in dealing with a well-matched enemy it must be assumed that it will be the case--the problem starts to grow horns, as Nietzsche would say, and becomes extremely complicated. Under such circumstances each small detail must be examined and worked out step by step; otherwise the entire tactical value of long-range intruder aircraft may be placed in jeopardy. The problem will be handled in greater detail below in the discussion of the technical aspects of intruder aircraft.

2. Against Naval Targets. The employment of long-range intruder aircraft against floating targets is relatively simple. First, the area in which the targets are moving is clearly defined and can be scanned with relative ease; second, the speed of naval targets is far less than that of aircraft; third, naval targets are much easier to recognize on a radar screen than aircraft flying over land. Once an intruder aircraft has located a naval target, it remains with it until the arrival of friendly attacking forces, either air or naval units or a combination of both.



V. THE TACTICAL AND TECHNICAL REQUIREMENTS WHICH MUST BE MET BY LONG-RANGE INTRUDER AIRCRAFT

In view of the principles of employment which have just been discussed, what are the tactical and technical requirements which must be met, first, by the radio and radar equipment of a long-range intruder aircraft, and second, by the airplane itself in respect to aeronautical characteristics and performance? Inasmuch as the radio and radar equipment is the more important, it will be considered first. The characteristics and the performance of the aircraft depend largely upon this equipment.

1. Radio and Radar Equipment.

a. A long-range, all-weather intruder aircraft must be equipped with an airborne panoramic[2] radar with the longest possible range, but at least 300 kilometers at approximately 20,000 meters altitude, ideally with near resolving power,[3] and with a device for distinguishing friend from foe.

b. There must be one or more airborne radio sets which can guarantee safe communication over the greatest possible distances.

c. There must be one or more fighter aircraft control instruments, by means of which the shadowing plane can guide friendly fighters to the enemy aircraft with certainty.

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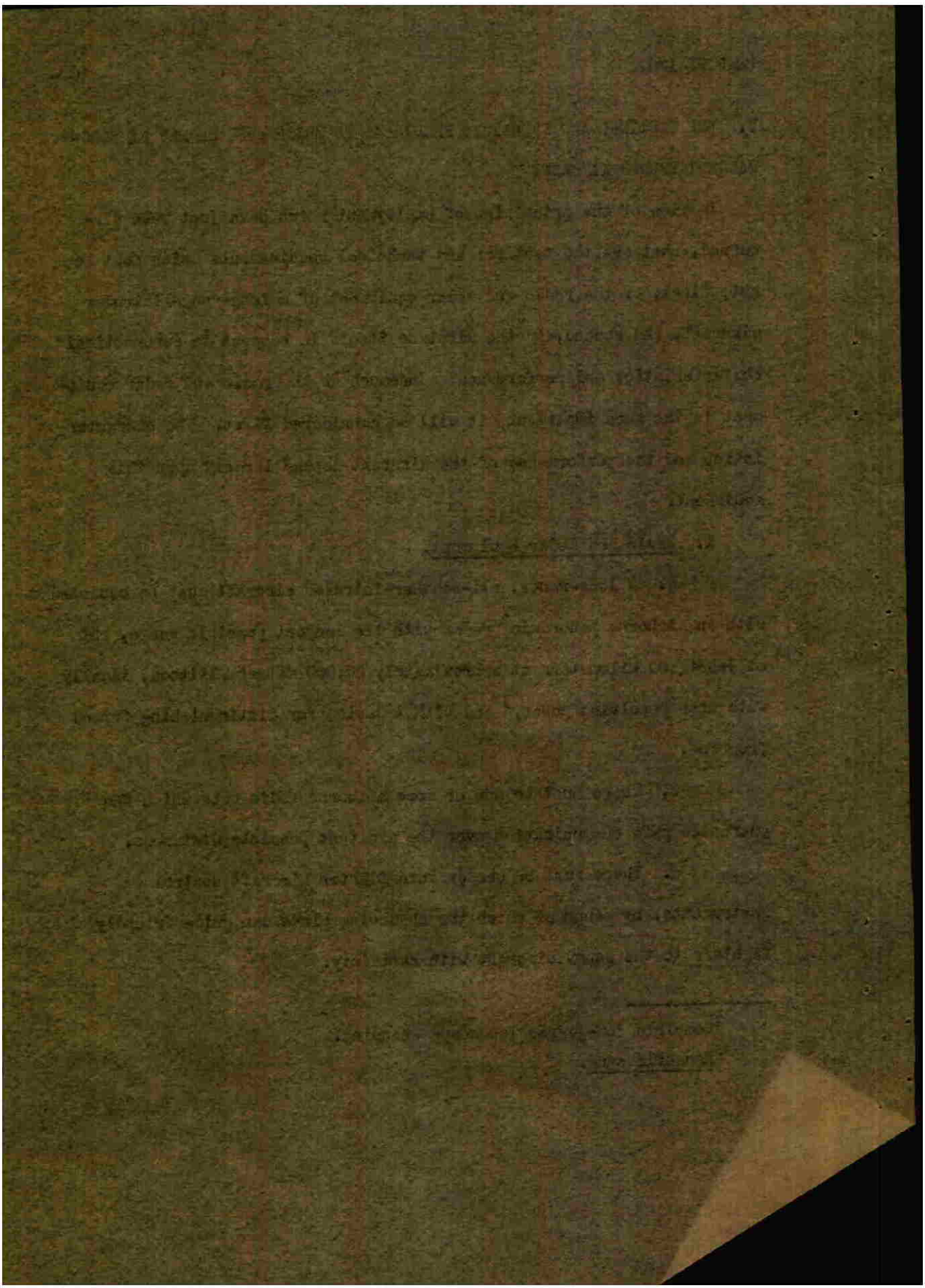
[2] Complete 360-degree landscape scanning.

[3] Nahaufloesung.



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d. There must be a sufficient number of devices which can jam enemy electronic instruments; mitigate, avoid, or nullify enemy jamming; and give warning against an attack by enemy fighter aircraft. By using the Lugenbold[4] (liar) some protection is afforded against radio-controlled rockets.

e. The aircraft must be provided with radio navigation instruments for independent direction finding, ground-to-air direction finding, astronomical navigation, instrument flying, flight safety, and bad-weather landings.

2. Aeronautical Characteristics and Performance. In view of the extensive radio and radar equipment required by long-range intruder aircraft, only superaircraft, capable of being made into "flying laboratories,"[5] should be used for this purpose. The most practical choice is a superbomber which has been modified in construction so that the necessary radio and radar equipment can be built into the space normally used for the bomb cargo. Only such a space can contain the panoramic radar equipment with a range of at least 300 kilometers, the long-range, powerful radio transmitter, the fighter aircraft control instruments, the television transmitters, the jamming transmitters, and other electronic equipment.

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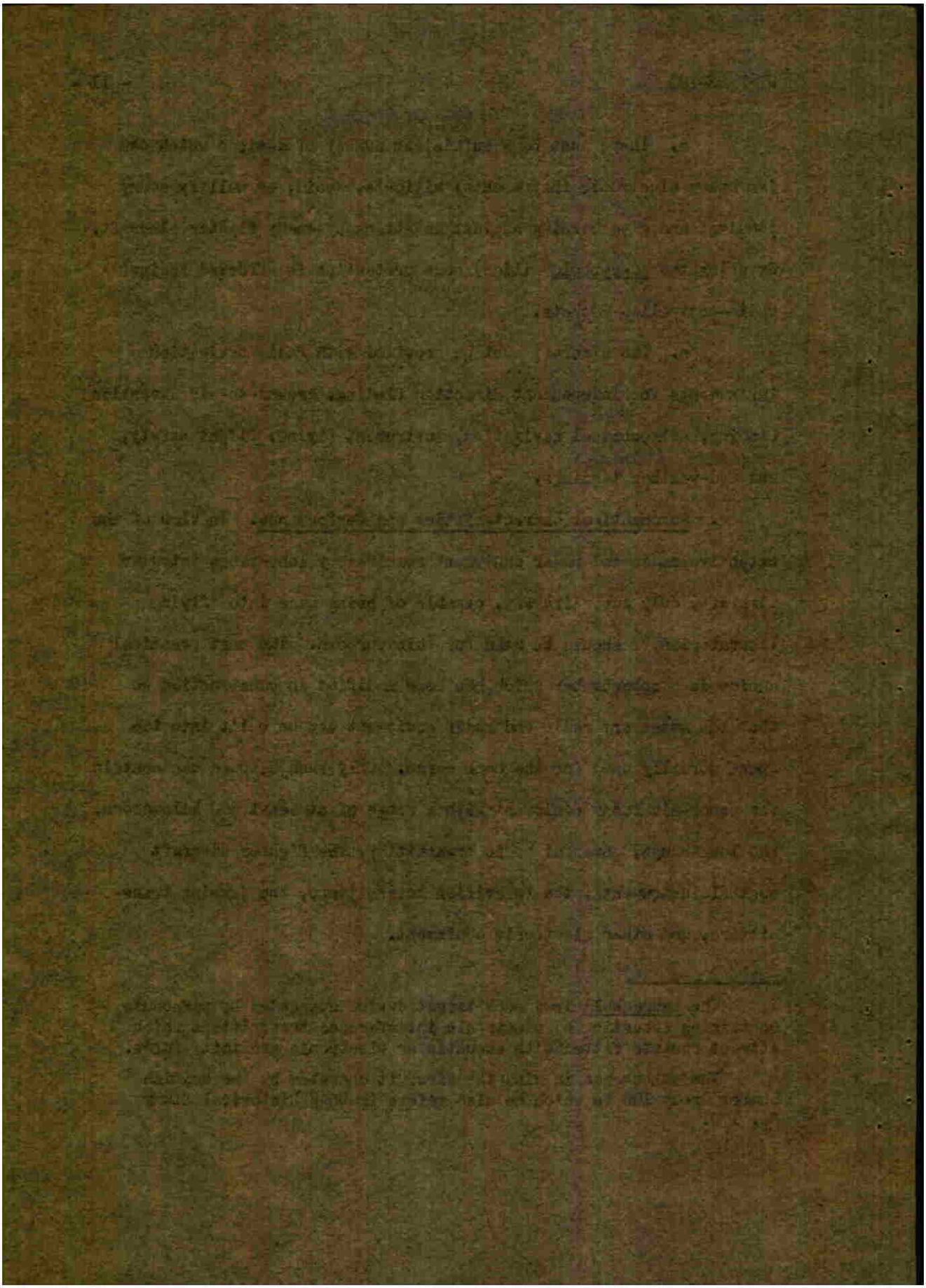
[4]The Lugenbold is a mock target device suspended by parachute containing acoustic and electronic interference transmitters which attract rockets fitted with acoustic or electronic proximity fuses.

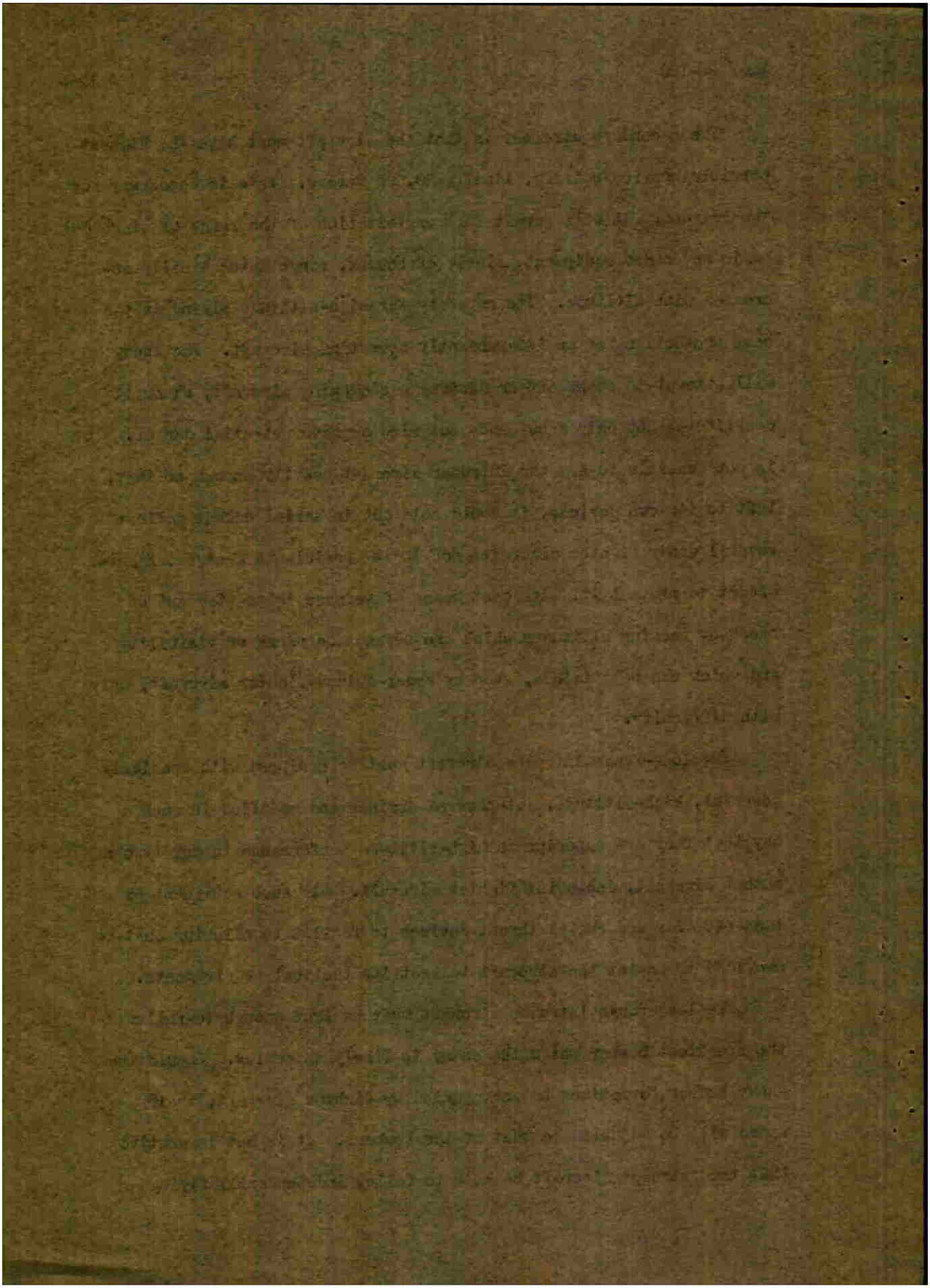
[5]The author has in mind the aircraft operated by the British Bomber Group 100 to which he also refers in USAF Historical Study No. 179.



The second requirement is that the aircraft must have the highest possible service ceiling, ideally 20,000 meters. This is necessary for two reasons. It will permit full exploitation of the range of airborne radio and radar equipment, since, of course, range automatically increases with altitude. Its capacity for high-altitude flying is the best protection for an independently operating aircraft. The enemy will attempt to shake off or destroy a shadowing aircraft, since it constitutes not only a nuisance but also a grave potential danger. It is not feasible to arm the intruder aircraft heavily enough so that, left to its own devices, it could hold out in aerial combat against several enemy fighter aircraft; nor is it possible to assign a fighter escort to protect it. Its best means of defense is to stay out of reach by seeking altitudes which are beyond the range of visibility and which can be attained, even by radar-guided fighter aircraft, only with difficulty.

The long-range intruder aircraft must be equipped with specially powerful, high-altitude, jet-powered engines and modified in such a way that they are superior in high-altitude performance to any type of combat aircraft, including fighter aircraft. All such equipment as take-off aids and rocket thrust devices to facilitate climbing must be provided to assist the aircraft to meet its tactical requirements.

The long-range intruder aircraft must be fast enough to follow the speediest bomber which the enemy is likely to employ. Should the enemy bomber formations be accompanied by fighter aircraft, their speed will be adjusted to that of the bombers. It is not imperative that the intruder aircraft be able to follow independently flying



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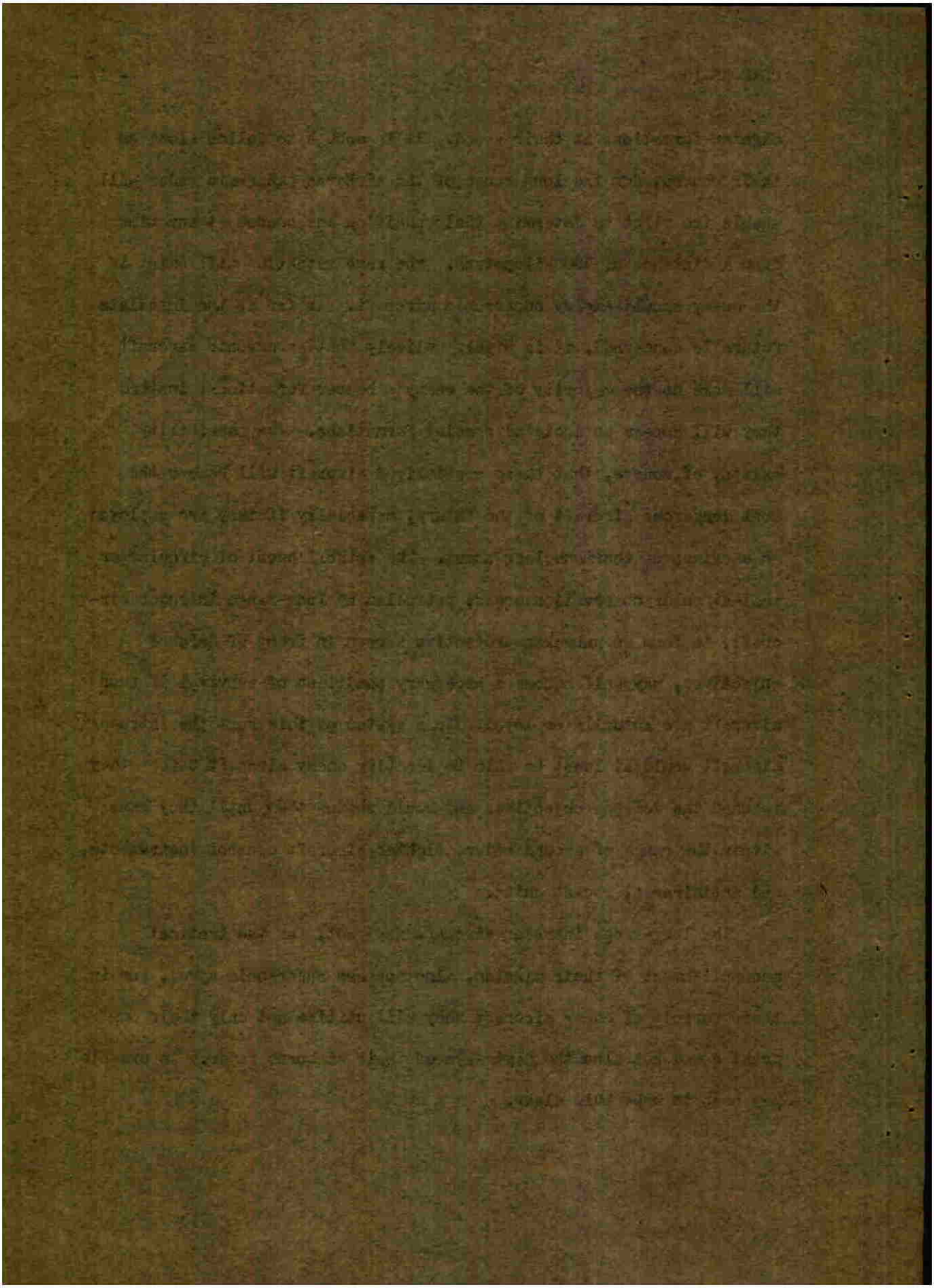
fighter formations at their speed. It is enough to follow along on their course, for the long range of the airborne panoramic radar will enable the pilot to determine their position and course at any time from a distance of 300 kilometers. The same situation will exist if the enemy should employ supersonic aircraft. As far as the immediate future is concerned, it is highly unlikely that supersonic aircraft will make up the majority of the enemy's bomber formations; instead they will appear as isolated special formations. The possibility exists, of course, that these specialized aircraft will become the most dangerous aircraft of the future, especially if they are employed as carriers of thermonuclear bombs. The establishment of circular or semi-circular observation areas, patrolled by long-range intruder aircraft, to form an unbroken protective screen in front of defense objectives, may well become a necessary condition of survival if such aircraft are actually employed. In a system of this sort the intruder aircraft would at least be able to identify enemy aircraft before they reached the defense objectives and could shadow them until they came within the range of ground radar, fighter aircraft control instruments, and antiaircraft rocket units.

The long-range intruder aircraft need not, for the tactical accomplishment of their mission, also possess supersonic speed, for in their pursuit of enemy aircraft they will utilize not only their own great speed but also the magic eye of their airborne radar. An example may help to make this clear.



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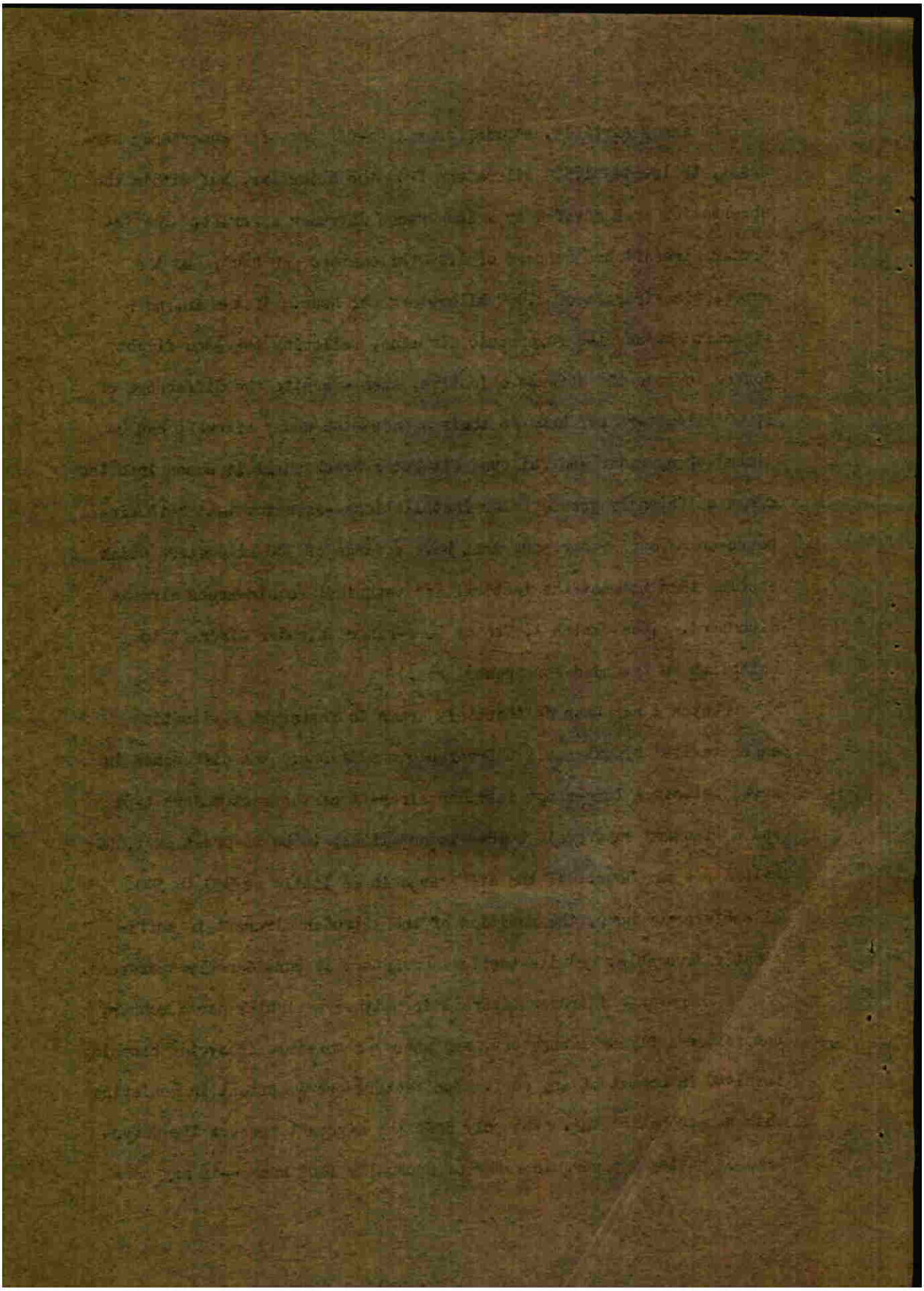
An enemy airfield, serving as a take-off base for supersonic aircraft, is located 1,500 kilometers from the objective, but within the observation area covered by a long-range intruder aircraft. The intruder aircraft has a speed of 1,000 kilometers per hour, and the supersonic aircraft of 2,000 kilometers per hour. If the intruder aircraft shadows the supersonic airplane, following the same flight course towards the defense objective, then—despite the difference of 1,000 kilometers per hour in their speeds—the enemy aircraft can be picked up by radar and followed without a break until it comes into the range of friendly ground radar installations—assuming that both airborne and ground radar equipment have a range of 300 kilometers which enables them to meet the tactical and technical requirements already discussed. (See Sketch 1, Use of Long-range Intruder Aircraft to Establish an Extended Foreground Area.)

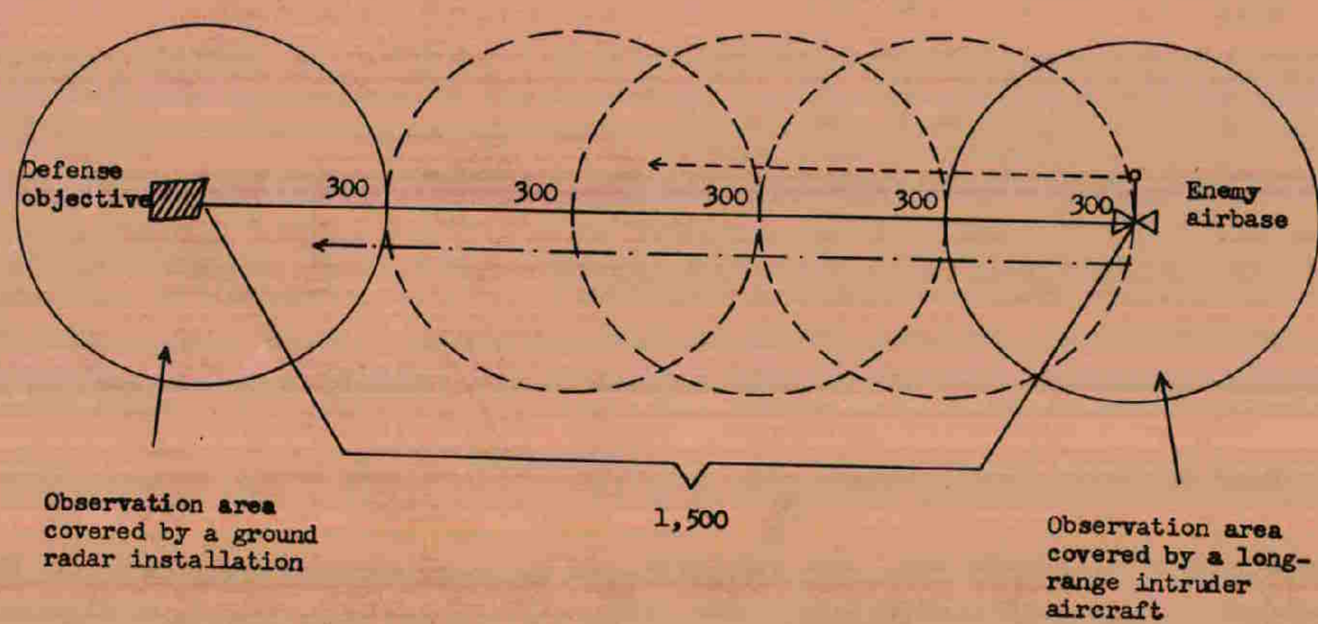
Sketch 1 has been deliberately drawn to represent a situation characterized by extremely unfavorable conditions. The difference in speed between a long-range intruder aircraft of the most modern type and a standard supersonic bomber is not likely to be as great as 1,000 kilometers per hour. If the difference is as little as 300 to 500 kilometers per hour, the position of the intruder aircraft is sufficiently favorable, and its tactical advantage is considerably increased.

A long-range intruder aircraft is neither a fighter nor a bomber, but rather a flying laboratory, and whenever possible it avoids becoming involved in combat of any sort. Two factors are important in achieving this non-combat status. Not only does the aircraft possess the advantage of having a panoramic radar of unusually long range—in any case



Sketch 1

USE OF LONG-RANGE INTRUDER AIRCRAFT TO ESTABLISH AN EXTENDED FOREGROUND AREA



- - - - - - - - - - → Flight course of the shadowing aircraft (1,000 kilometers per hour)

—— · —— · —— · → Flight course of an emeny supersonic bomber (2,000 kilometers per hour)

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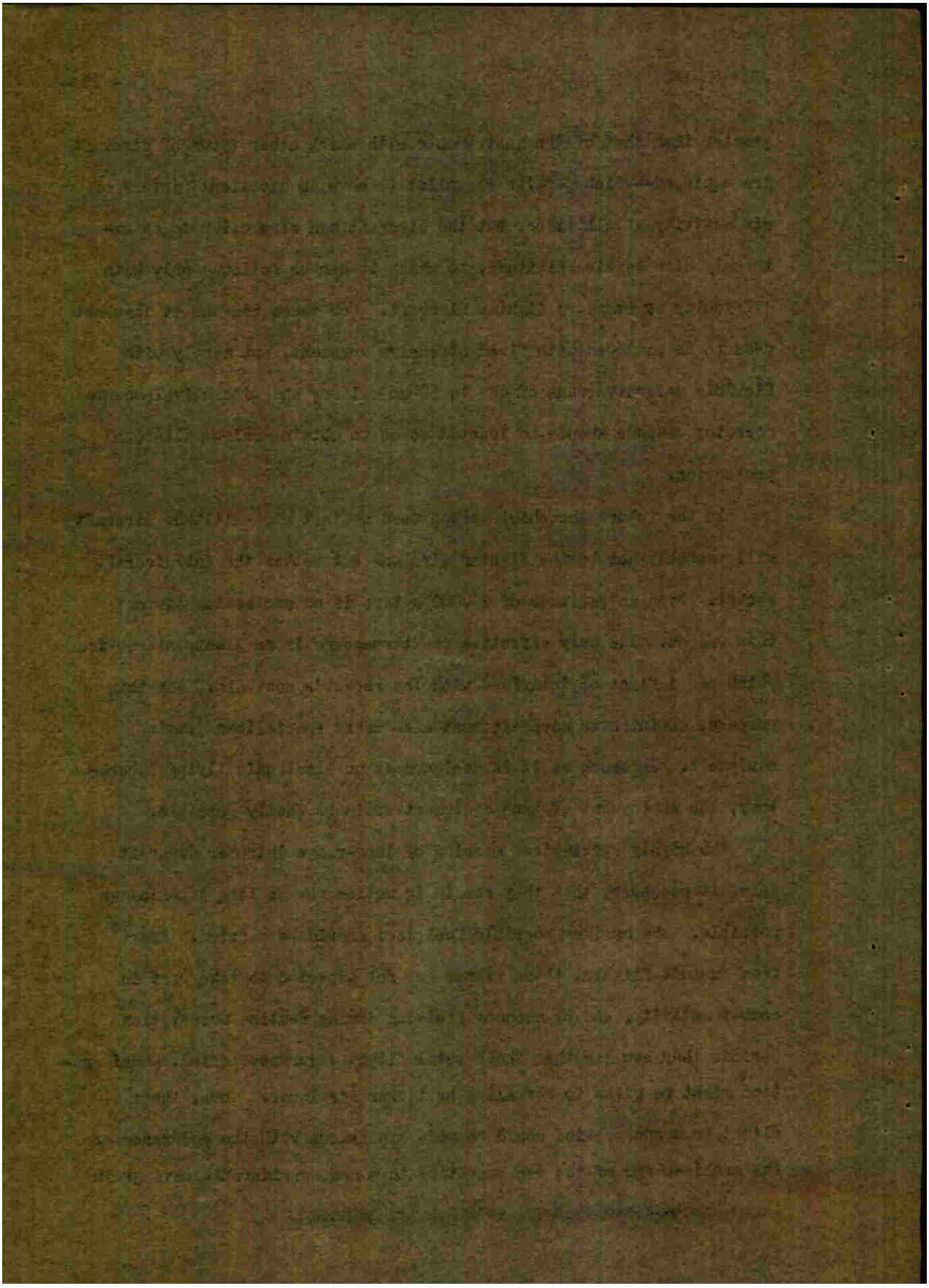
greater than that of the instruments with which other types of aircraft are equipped--which permits its pilot to have an excellent picture of air activity at all times, but the aircraft can also climb to an extremely high service altitude, to which it can be followed only with difficulty by standard fighter aircraft. For these reasons it does not need to be equipped with fixed offensive armament, but merely with flexible defensive guns of 20- to 50-mm caliber and with swivel-mounted rockets; weapons should be located so as to obtain maximum all-round protection.

In the future the chief weapon used against high-altitude aircraft will probably not be the fighter airplane but rather the antiaircraft rocket. Even an altitude of 20,000 meters is no protection against this weapon. The only effective countermeasure is an electronic device which can deflect or interfere with the rocket's controls. For this purpose, an intruder aircraft must also carry specialized jamming equipment. Inasmuch as it is designed as an electronic flying laboratory, the employment of such equipment would be easily possible.

The highly specialized mission of long-range intruder aircraft makes it necessary that they remain in action for as long a period as possible. The maximum possible fuel load should be carried. Apart from pursuit flights, these planes are not expected to take part in combat activity, and by economy cruising during routine observation periods they can lengthen their total flight endurance period. Consideration might be given to refueling by tanker airplanes. Thus, their flight endurance period could be made synonymous with the endurance of the machines and of the men operating them and considerable savings in



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these highly specialized aircraft would result. The long-range intruder aircraft must be provided with all the usual equipment upon which flight safety depends, such as de-icer, pressurization, and heating systems.

3. Organization and Equipment as a Fighter Aircraft Control Station.

Why should this long-range, highly specialized aircraft, which is provided with all the radio and radar equipment needed to meet the tactical and technical requirements discussed above, be employed only as a flying laboratory for the purpose of obtaining a picture of air activities and of transmitting information? Why not use it as an aerial fighter station under the direction of a fighter aircraft control officer?

It would only be necessary to enlarge the crew to include a fighter aircraft control officer and provide him with suitable aircraft control equipment. He would then be able not only to direct approaching friendly fighter formations toward enemy aircraft but also to control them during aerial combat, just as he could from an air defense division headquarters on the ground.[6] This would enable friendly fighter aircraft to deal effectively with enemy bomber formations long before they enter the range of even those ground radar and aircraft control stations located nearest the enemy base; the only limiting factor would be the range of the fighter planes themselves. It is quite conceivable that the depth now required for an extended

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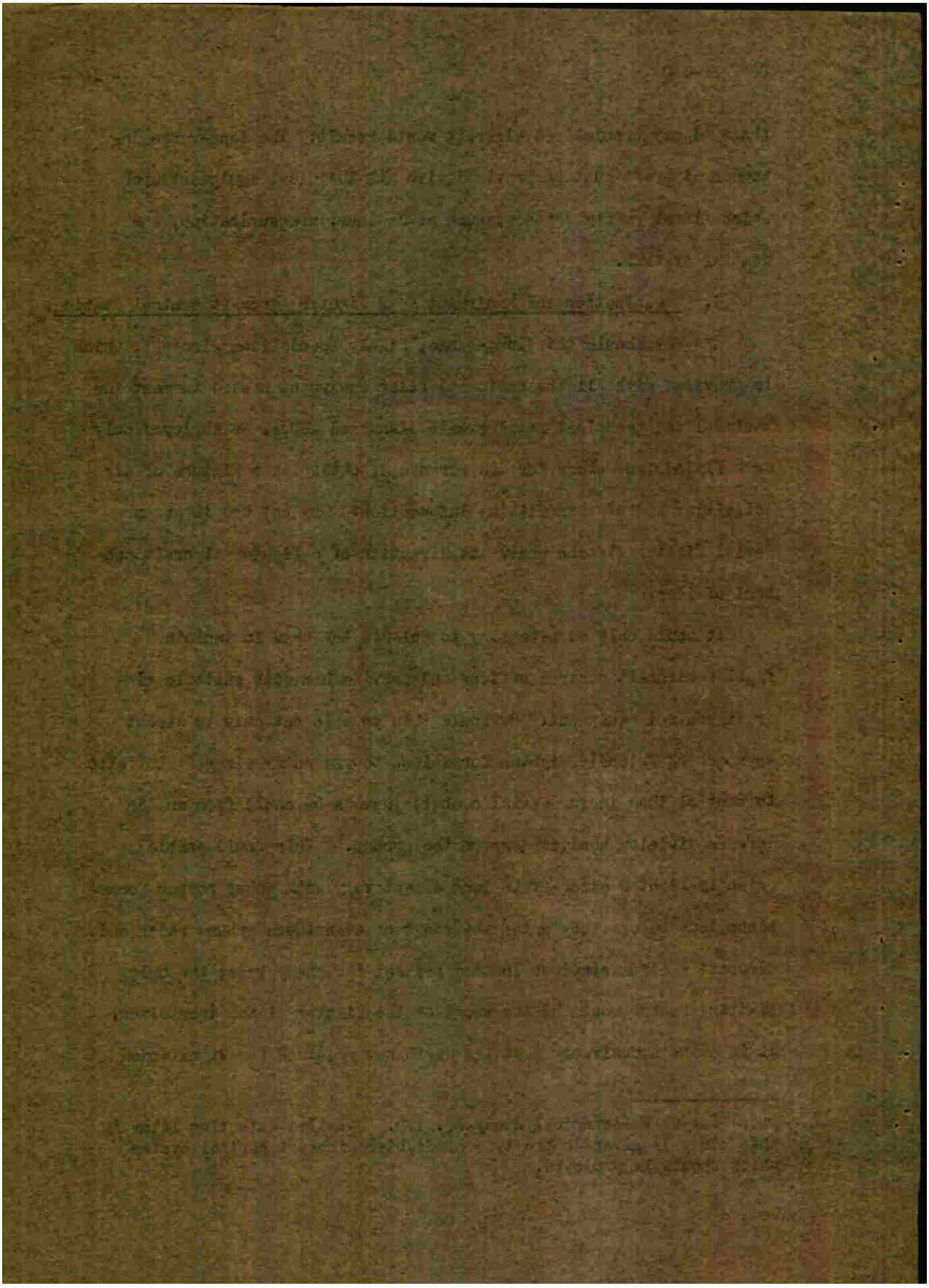
[6] See USAF Historical Study No. 179. Detailed attention later in this study is given to the type of fighter aircraft control system which should be employed.



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foreground area for a home defense fighter aircraft organization might be revised entirely, because the goal of any home air defense organization is to head off the enemy during his approach flight and inflict such heavy losses upon him that he will turn back before reaching his target.

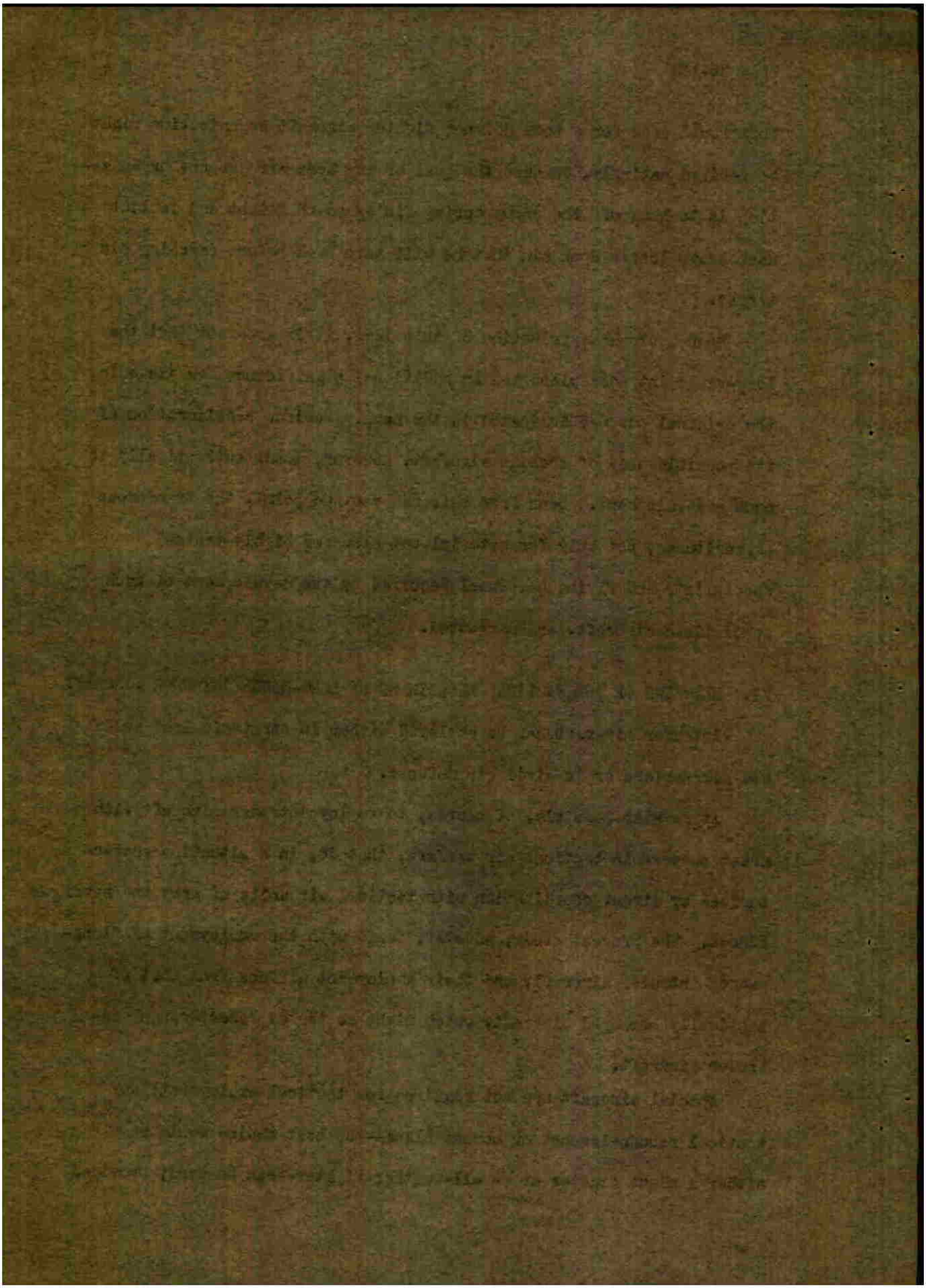
Upon a closer examination of this idea, it is apparent that the long-range intruder plane has an additional significance far exceeding the original purpose indicated in the name. Serious consideration of the possible uses of such an aircraft, however, leads automatically to such a development. Seen from this new vantage point, the tremendous expenditures, not only for material but also for highly-trained specialists and flying personnel required by the development of such specialized aircraft, are warranted.

VI. EXAMPLES OF THE TACTICAL EMPLOYMENT OF LONG-RANGE INTRUDER AIRCRAFT

Intruder aircraft can be employed either in strategic land and sea air warfare or in civil air defense.

It is also possible, of course, to employ intruder aircraft with great success in tactical air warfare, that is, in a situation characterized by direct coordination with tactical air units of army and naval forces. The present study, however, deals with the employment of "long-range" intruder aircraft, and their employment differs from that of tactically employed aircraft, which might be termed "short-range" intruder aircraft.

Special aircraft are not required for tactical employment; any tactical reconnaissance or combat plane--the best choice would be either a night fighter or an all-weather fighter--can be used, provided



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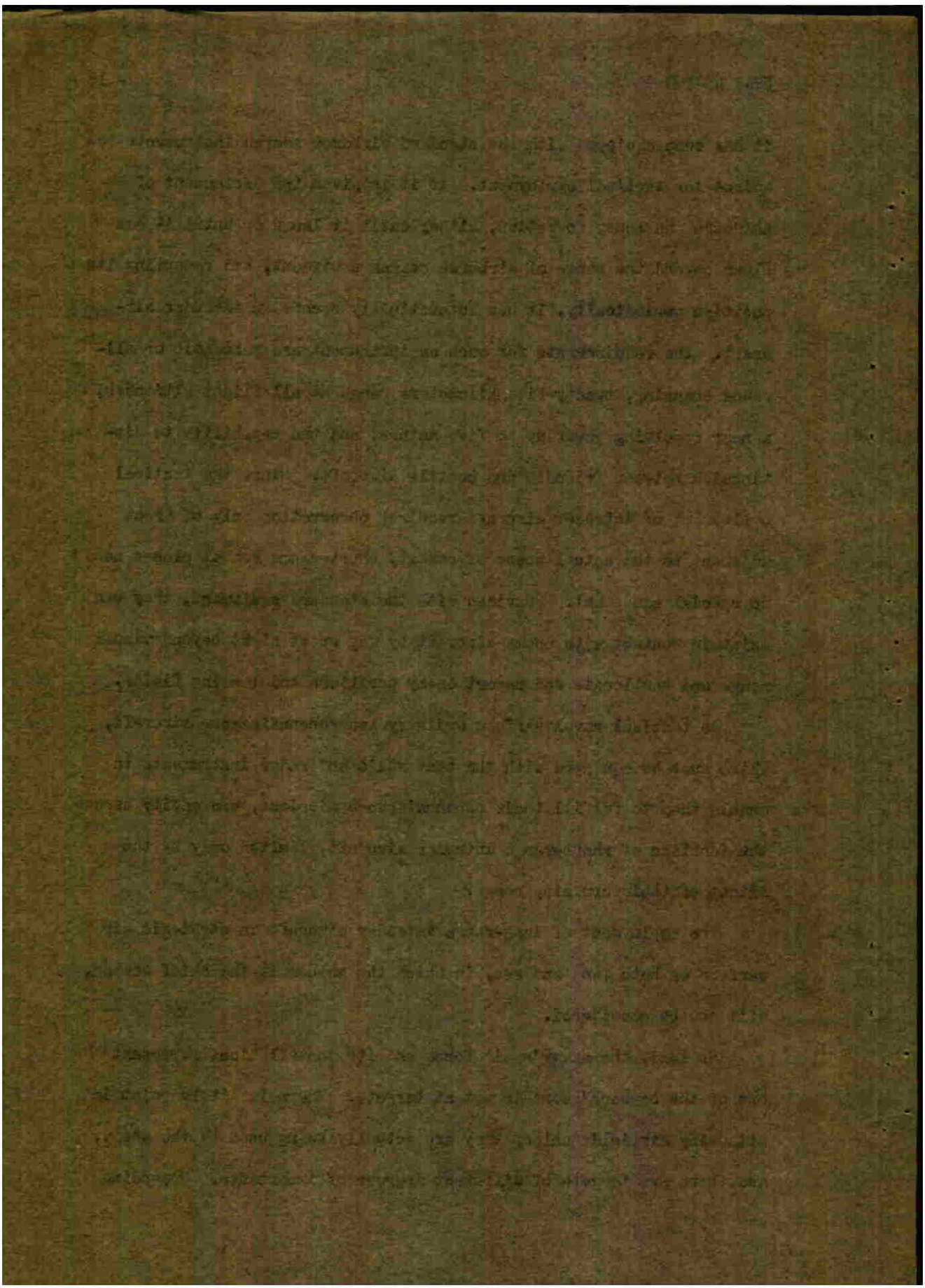
it has been equipped with the standard airborne search instruments required for tactical employment. If it is given the assignment of shadowing an enemy formation, either until it lands or until it has flown beyond the range of airborne search equipment, and reporting its position periodically, it has automatically become an intruder aircraft. The requirements for such an instrument are panoramic or all-round scanning, twenty-five kilometers range at all flight altitudes, a near resolving power up to five meters, and the capability to distinguish between friendly and hostile aircraft. Since the tactical employment of intruder aircraft requires observation only of areas adjacent to the actual scene of combat, short-range combat planes need no special equipment. Provided with the standard equipment, they can maintain contact with enemy aircraft by day or at night beyond visual range and can locate and report enemy positions and landing fields.

In tactical naval warfare ordinary sea reconnaissance aircraft, which must be equipped with the best radio and radar instruments to enable them to fulfill their reconnaissance missions, can easily assume the function of short-range intruder aircraft, limited only by the extent of their cruising range.

The employment of long-range intruder aircraft in strategic air warfare on both land and sea, in which the bomber is the chief weapon, will now be considered.

On land, the enemy's air force and its installations represent one of the bombers' most important targets. There is little point in attacking airfields unless they are actually being used by the enemy, and there are targets of different degrees of importance. Depending



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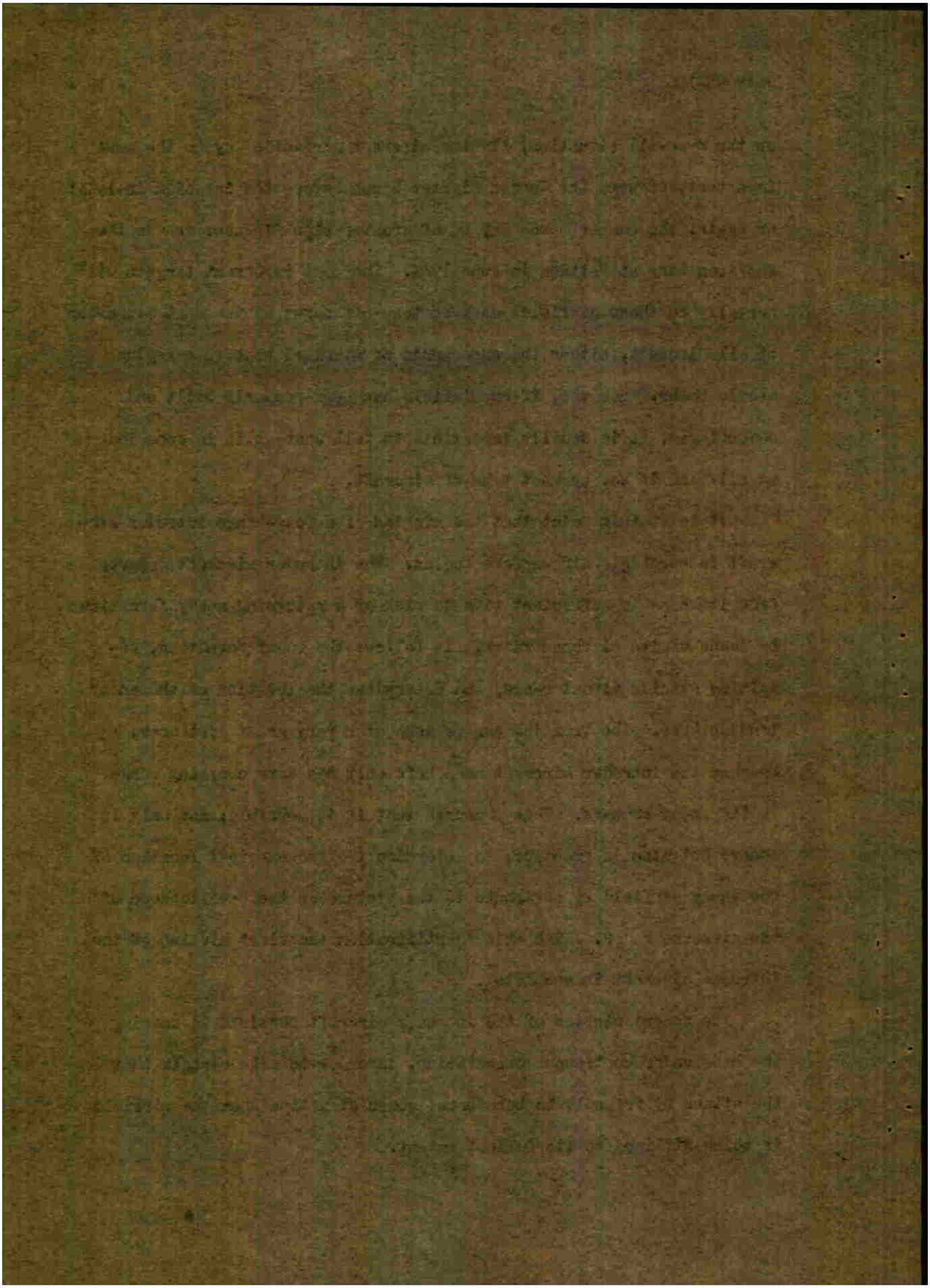
on the over-all situation, fighter aircraft airfields may be the most important, as were the German fighter bases before the invasion in 1944; or again, the bomber bases may be of greater significance, as was the American base at Poltawa in June 1944. The most important targets will normally be those airfields used as take-off bases by the most dangerous of all aircraft, either the supersonic or standard bombers carrying atomic bombs. However, if an airfield has been properly built and camouflaged, it is usually impossible to tell whether it is occupied at all, and if so, by what type of aircraft.

It is at this point that the mission of a long-range intruder aircraft in strategic air warfare begins. The intruder aircraft departs from its base in sufficient time to pick up a returning enemy formation by means of its airborne radar. It follows the enemy formation, remaining outside visual range, and determines the location of the enemy landing base. The trailing can be done over very great distances, because the intruder aircraft need have only the same cruising range as the enemy bombers. This presumes that it is possible, not only in theory but also in practice, to determine the geographical location of the enemy airfield by reference to the picture on the oscilloscope of the airborne radar. With this identification the first mission of the intruder aircraft is completed.

The second mission of the intruder aircraft consists in keeping the base under continuous observation, in order to make certain that the attack by friendly bomber forces comes at a time when the airfield is being utilized to its fullest extent.



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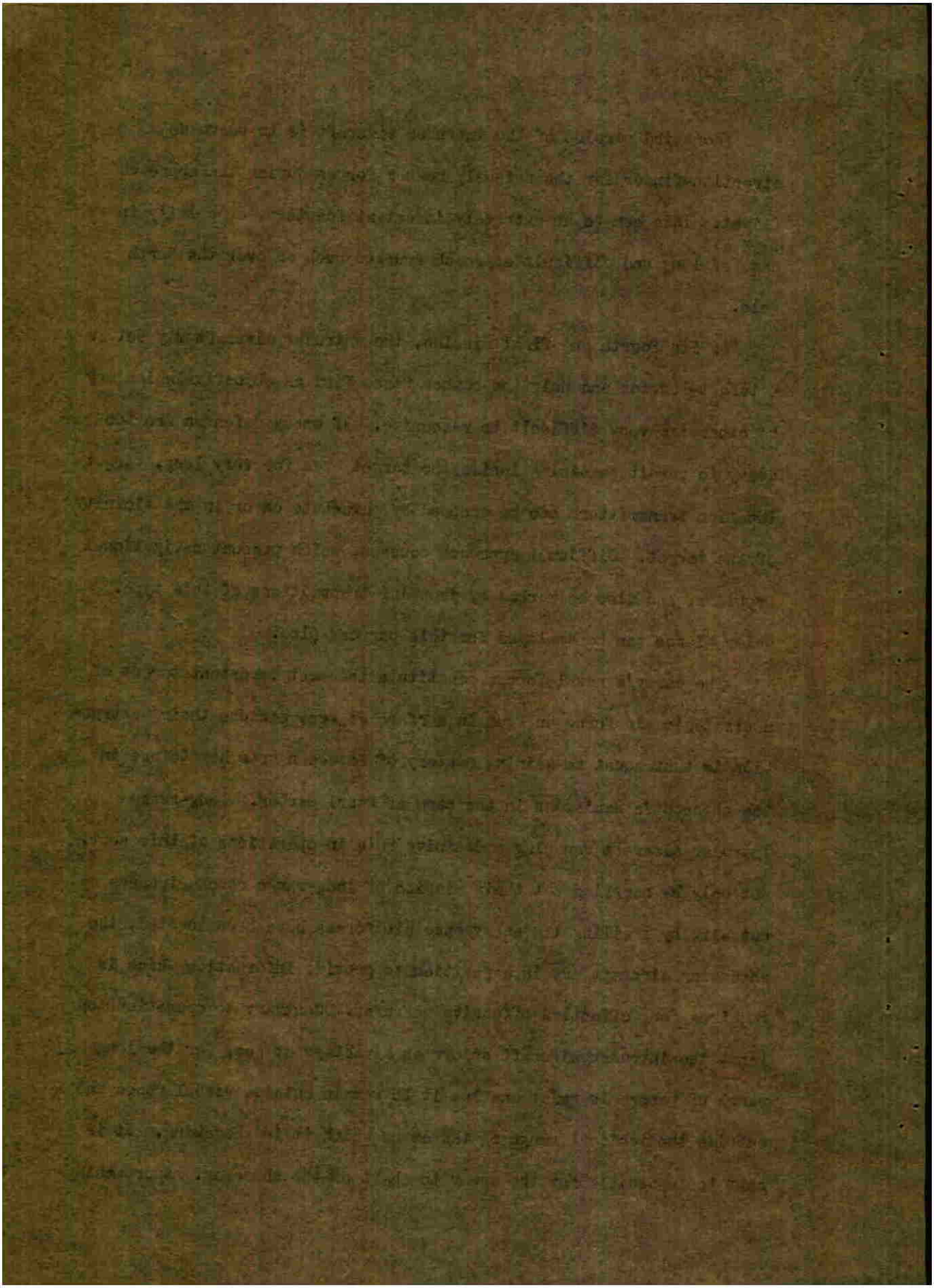
The third mission of the intruder aircraft is to serve as a direction-finder for the friendly bomber forces during the approach flight. This can be an extremely important function, especially in case of long and difficult approach courses such as over the North Pole.

As its fourth and final mission, the intruder aircraft may act as a target-locator and help the bomber force find an objective which may be otherwise very difficult to recognize. If enemy defenses are too heavy to permit remaining inside the target area for very long, target location transmitters can be dropped by parachute on or in the vicinity of the target. Difficult approach courses, which present navigational problems, can also be marked by dropping transmitters of this type. Relay planes can be employed for this purpose also.

The enemy's naval forces constitute the most important target of a strategic air force engaged in warfare at sea, because their destruction is tantamount to gaining mastery of an ocean area heretofore in the opponent's hands, as in the case of Pearl Harbor. Long-range intruder aircraft can play a decisive role in operations of this sort. Not only by carrying out their mission of long-range reconnaissance but also by trailing the enemy once his forces have been located, the shadowing aircraft are in a position to provide information which is required for effective offensive measures. Contrary to operations on land, the intruder aircraft enjoys an advantage at sea, for the long range of panoramic radar enables it to remain outside visual range and outside the tactical range of the enemy which it is shadowing. It is next to impossible for the enemy to shake off the shadower. Approaching



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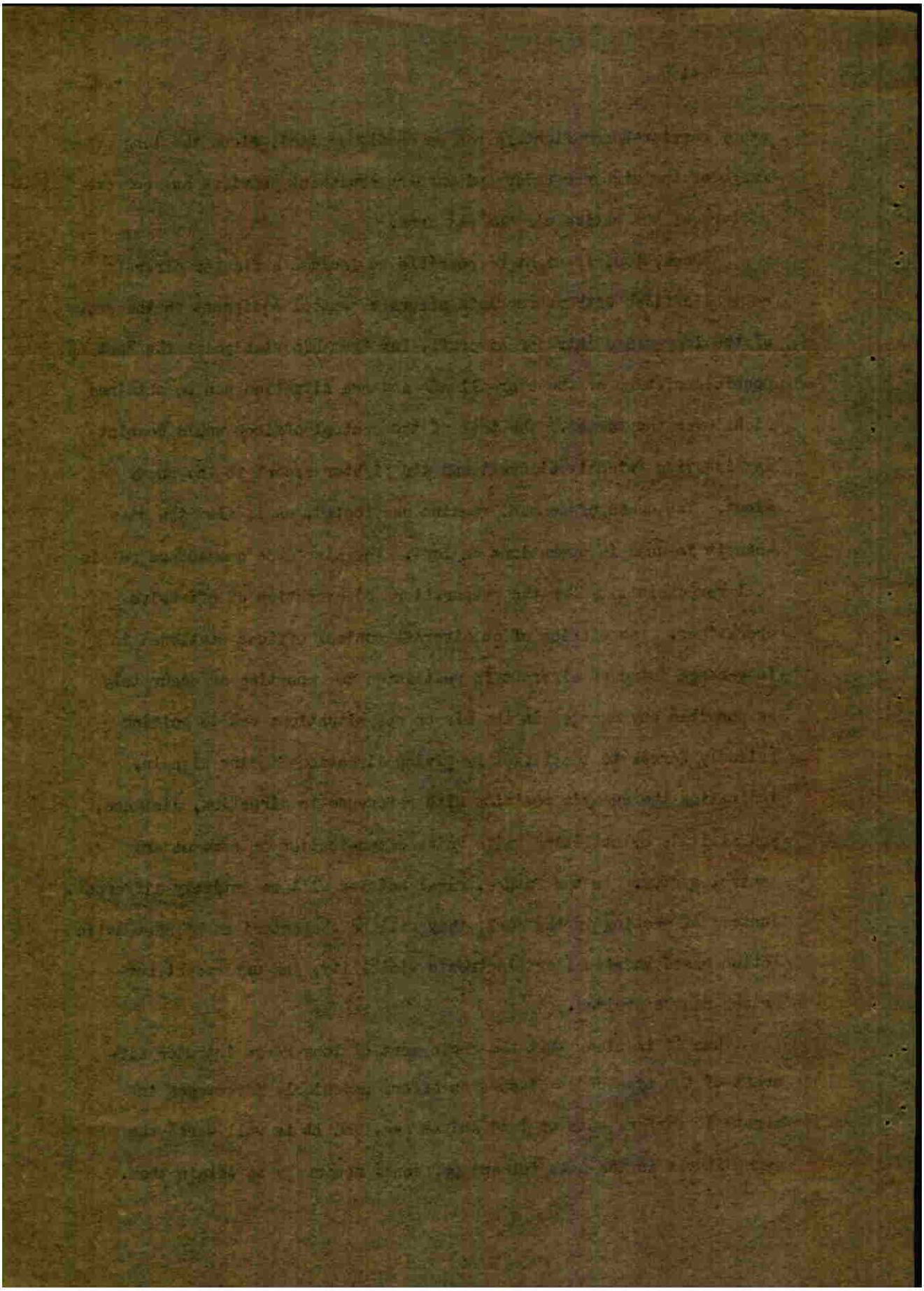
enemy carrier-based fighters can be easily avoided, since the long range of the airborne radar and warning equipment provides an accurate picture of the entire air and sea area.

At sea, too, it might be possible to include a fighter aircraft control officer with appropriate aircraft control equipment in the crew of the long-range intruder aircraft, for from his standpoint the best possible picture of the over-all air and sea situation can be obtained right over the target. The task of the control officer would consist in directing friendly aircraft and its fighter escort to the enemy fleet. The chain of command remains unaffected, as is also the case when it is used in operations on land. The air force commanders retain full responsibility for the preparation and execution of offensive operations. The mission of an aircraft control officer stationed in a long-range intruder aircraft is restricted to reporting as accurately as possible any changes in the air or sea situations and to guiding friendly forces to the target by giving direction-finding signals, indicating the enemy's position with reference to direction, distance, and altitude by utilising radio voice communication or some other control system. In the future, naval battles will be entirely different. Instead of groping in the dark, they will be characterized by systematic action based on visual or electronic visibility, and unpleasant surprises can be avoided.

Thus it is clear that the employment of long-range intruder aircraft of the type under discussion offers undeniable advantages in strategic warfare both on land and at sea, and it is well worth the expenditures in the materiel and personnel necessary to obtain them.



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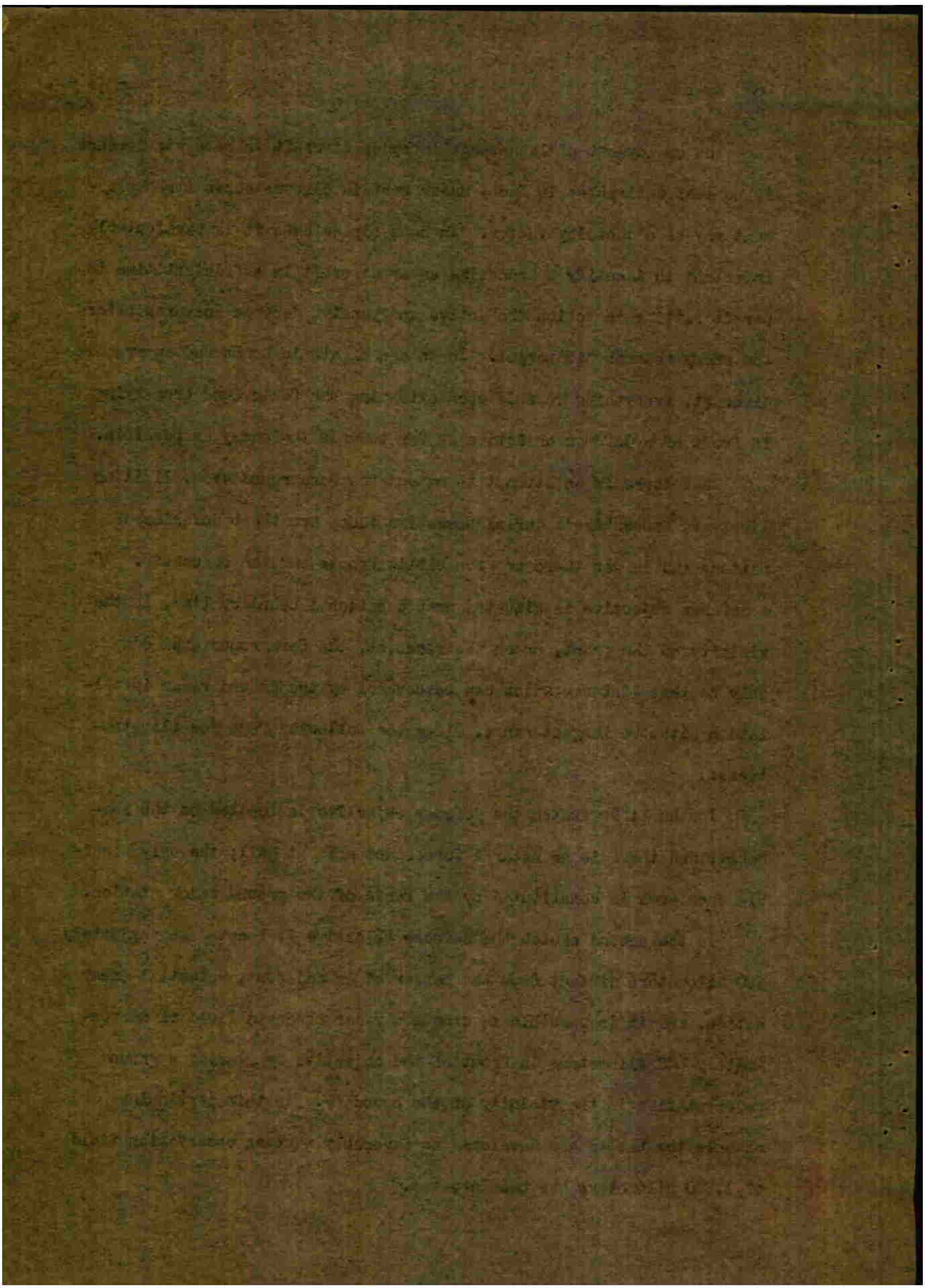
The employment of long-range intruder aircraft in home air defense is no less desirable; in fact, under certain circumstances its employment may be a deciding factor. In home air defense it is particularly important to identify approaching enemy aircraft in sufficient time to permit setting in motion the active and passive defense measures before the enemy reaches his target. In an age of atomic bombs and supersonic aircraft, everything depends upon extending the foreground area lying in front of a defense objective as far towards the enemy as possible.

When there is an attempt to extend the foreground area, limiting lines are encountered; during peacetime there are the boundaries of nations and in war there are the battle fronts and the seacoasts. If a defense objective is situated near a national boundary line, in the vicinity of the front, or on the seacoast, the foreground area can only be that distance which can be covered by the ground radar installation with the longest range. (See the following page for illustrations.)

In the first sketch the defense objective is located on the seacoast, and there is no natural foreground area at all; the only possible such area is constituted by the range of the ground radar station.

In the second sketch the defense objective is located approximately 350 kilometers distant from the border of an adjacent, potential enemy nation, and it is possible to create a radar observed field of approximately 600 kilometers in front of the objective by placing a ground radar station in the vicinity of the boundary. In this particular example the battle has developed so favorably that an observation field of 1,200 kilometers has been created.



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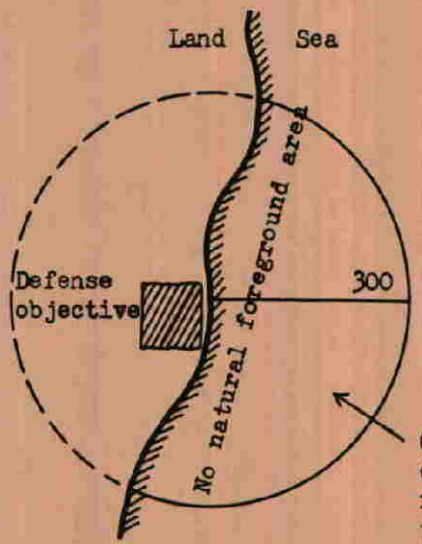
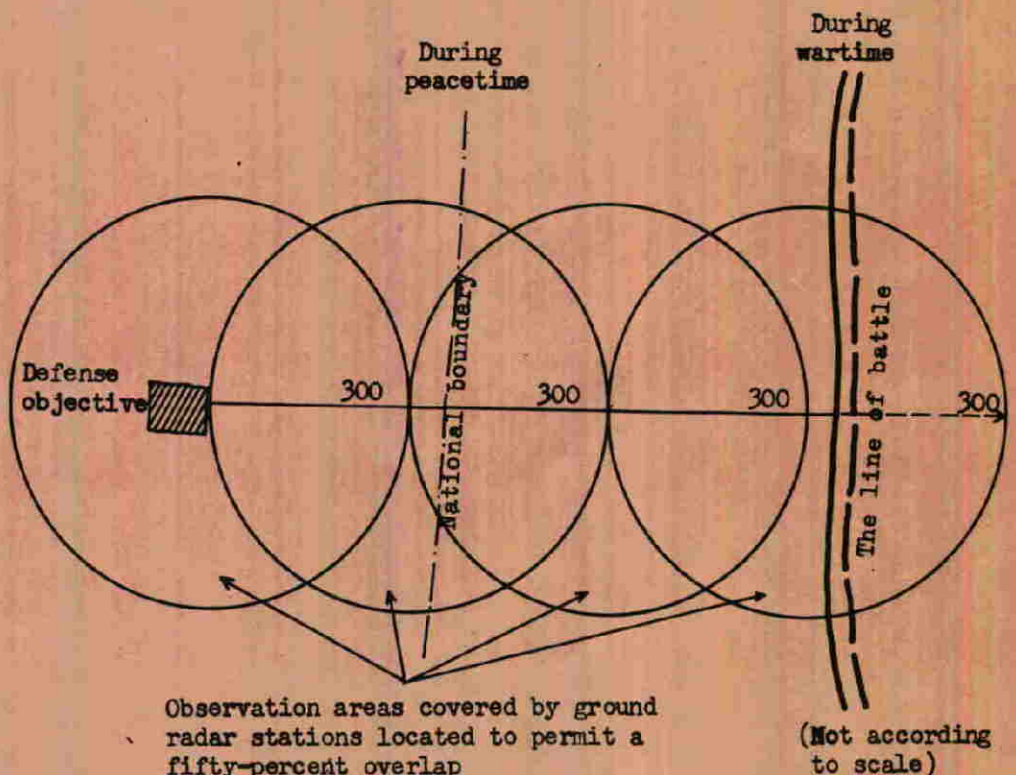
Sketch 2

FOREGROUND AREAS COVERED BY GROUND RADAR INSTALLATIONS



Sketch 3

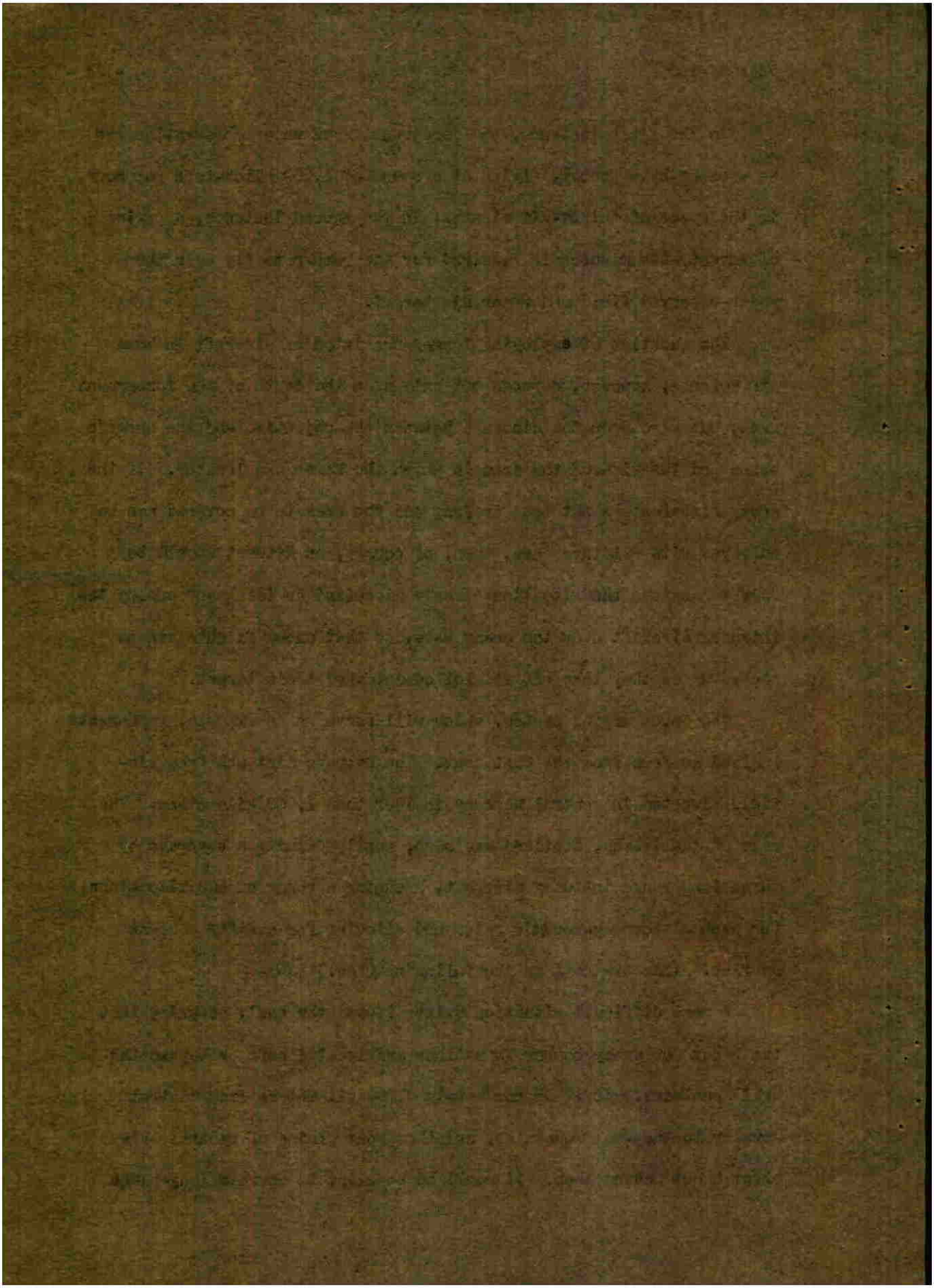


In the first instance, the foreground area under observation can be crossed by a bomber, flying at a speed of 1,000 kilometers per hour, in the space of thirty-six minutes; in the second instance, a period of seventy-two minutes is required for the bomber to fly over the radar-observed field and reach his target.

The question of employing long-range intruder aircraft in home air defense, however, depends not only upon the depth of the foreground area, but also upon the distance between the objective and the enemy's bases and the size of the area in which the bases are located. If the enemy airbases are not too far away and the area to be covered can be surveyed with relative ease, then, of course, an attempt should be made to achieve the situation already discussed as ideal and employ the intruder aircraft over the enemy base, so that enemy flights can be picked up as they take off and followed toward their target.

The accompanying sketch, which will serve as an example, represents England as seen from the Continent. The average distance from airfields located in central Germany is less than 1,000 kilometers. The size of the Island, Scotland excluded, easily permits a coverage by three long-range intruder aircraft, assuming a range of 300 kilometers for each airborne panoramic radar and allowing for a fifty percent overlap. (See Sketch 4 on the following page.)

A more difficult situation exists toward the east, assuming that the bases for enemy bomber formations are located near or beyond the Ural Mountains. It is approximately 3,000 kilometers from central Germany to the Ural Mountains, and the broad plains of central Asia stretch out behind them. It would be hopeless to operate long-range



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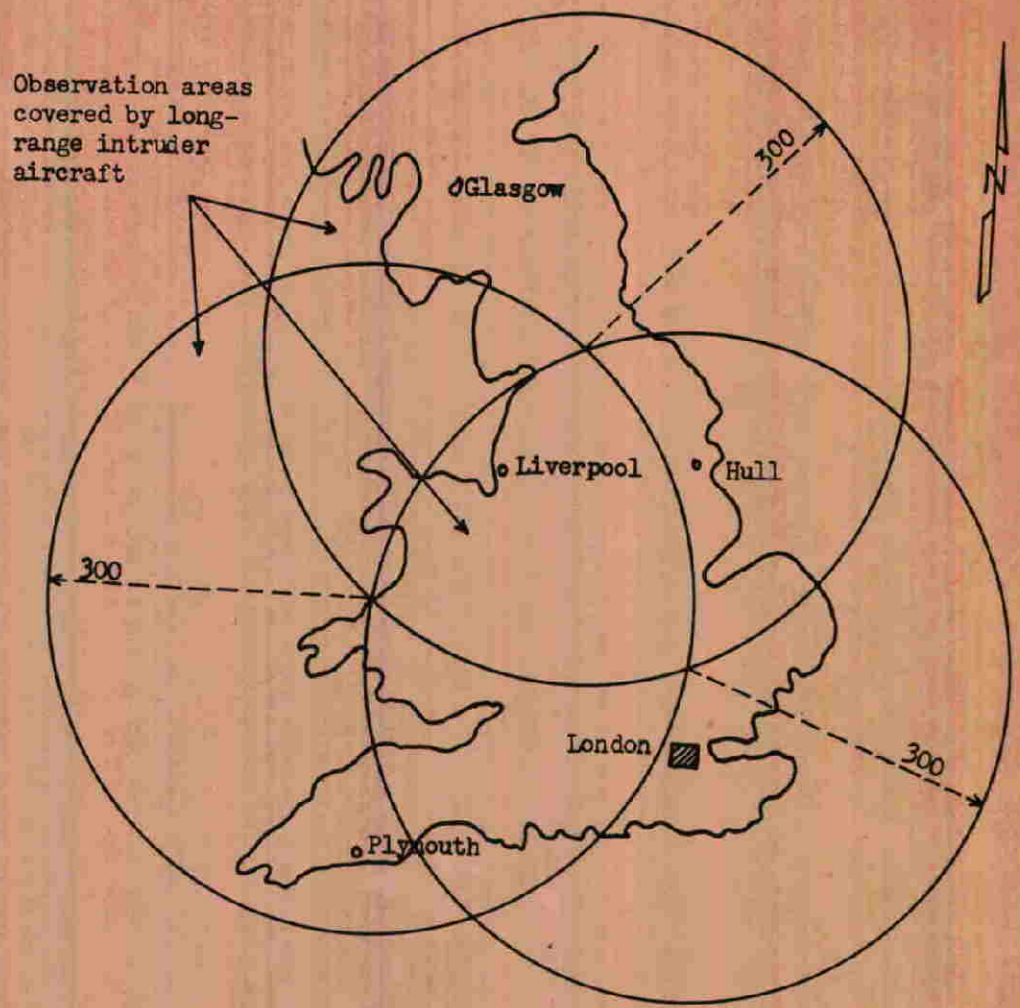
Sketch 4

THE LONG-RANGE INTRUDER AIRCRAFT USED

TO EXTEND THE FOREGROUND AREA



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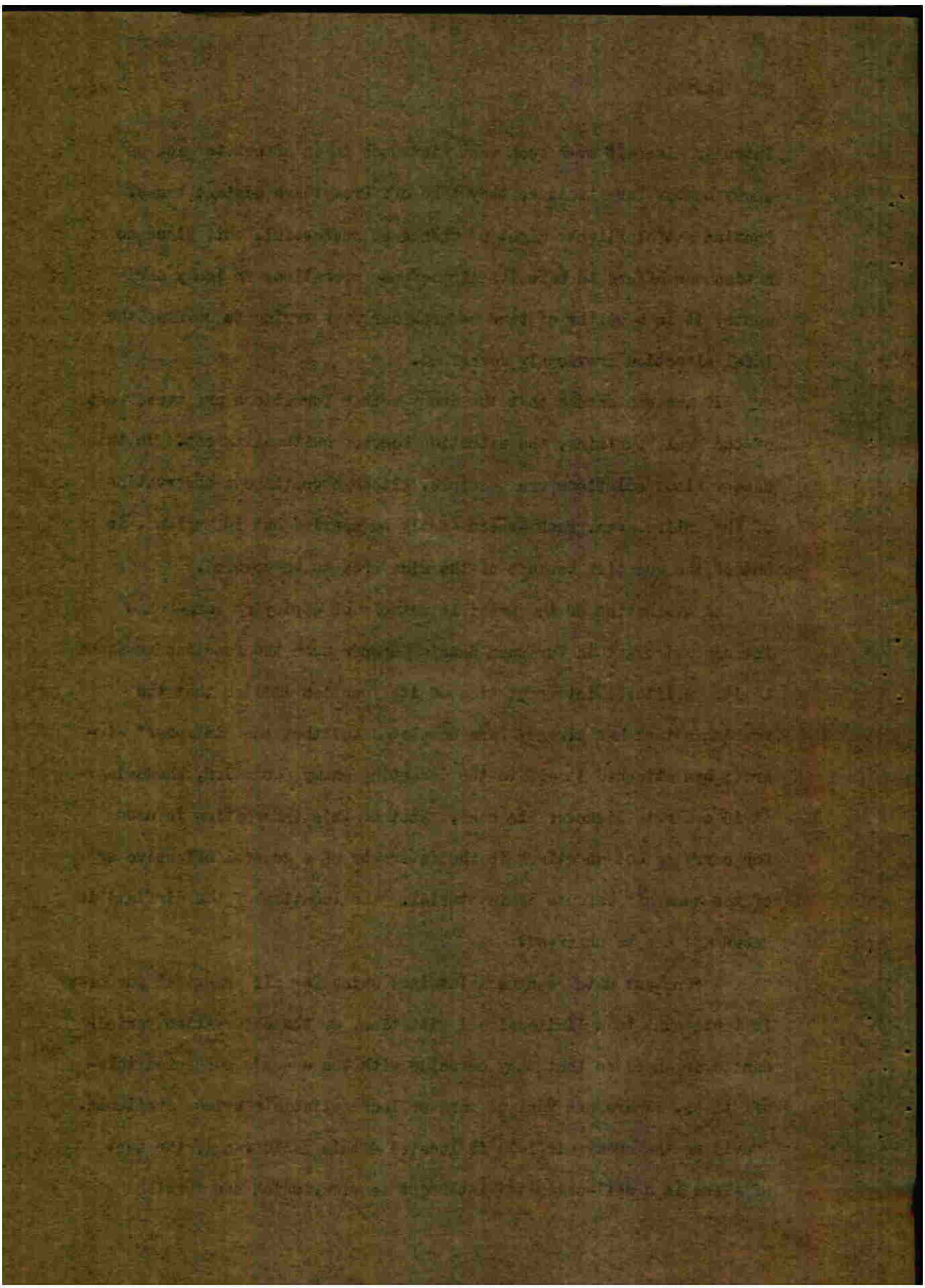
intruder aircraft over such vast distances in an effort to pick up enemy bomber formations as they take off from these distant bases. Routine patrol flights might by chance be successful, but, since no nation can afford to base its air defense operations on lucky accidents, it is a waste of time to consider even trying to develop the ideal situation previously described.

If one can assume that the enemy bomber formations are based west of the Ural Mountains, the situation becomes quite different. In this case various solutions are possible, although continuous observation of the entire area, such as can easily be carried out in England, is out of the question because of the wide area to be covered.

An evaluation of the possible methods of employing long-range intruder aircraft in European Russia depends upon the function assigned to it. A literal interpretation of its function implies that the bombing attack has already been completed and that the "intruder" aircraft has attached itself to the departing enemy formation, shadowing it in order to discover its base. Whether this information is used for carrying out an attack in the interests of a general offensive or of the home air defense is immaterial. The location of the airfield is known and can be observed.

A constant watch can be maintained which for all practical purposes is tantamount to a limited ideal situation, or the observation periods can be arranged so that they coincide with the enemy's suspected take-off times. There are various more or less reliable services available. Providing the enemy airfield is located within radio range, the best of these is a well-organized intercept service, which can furnish



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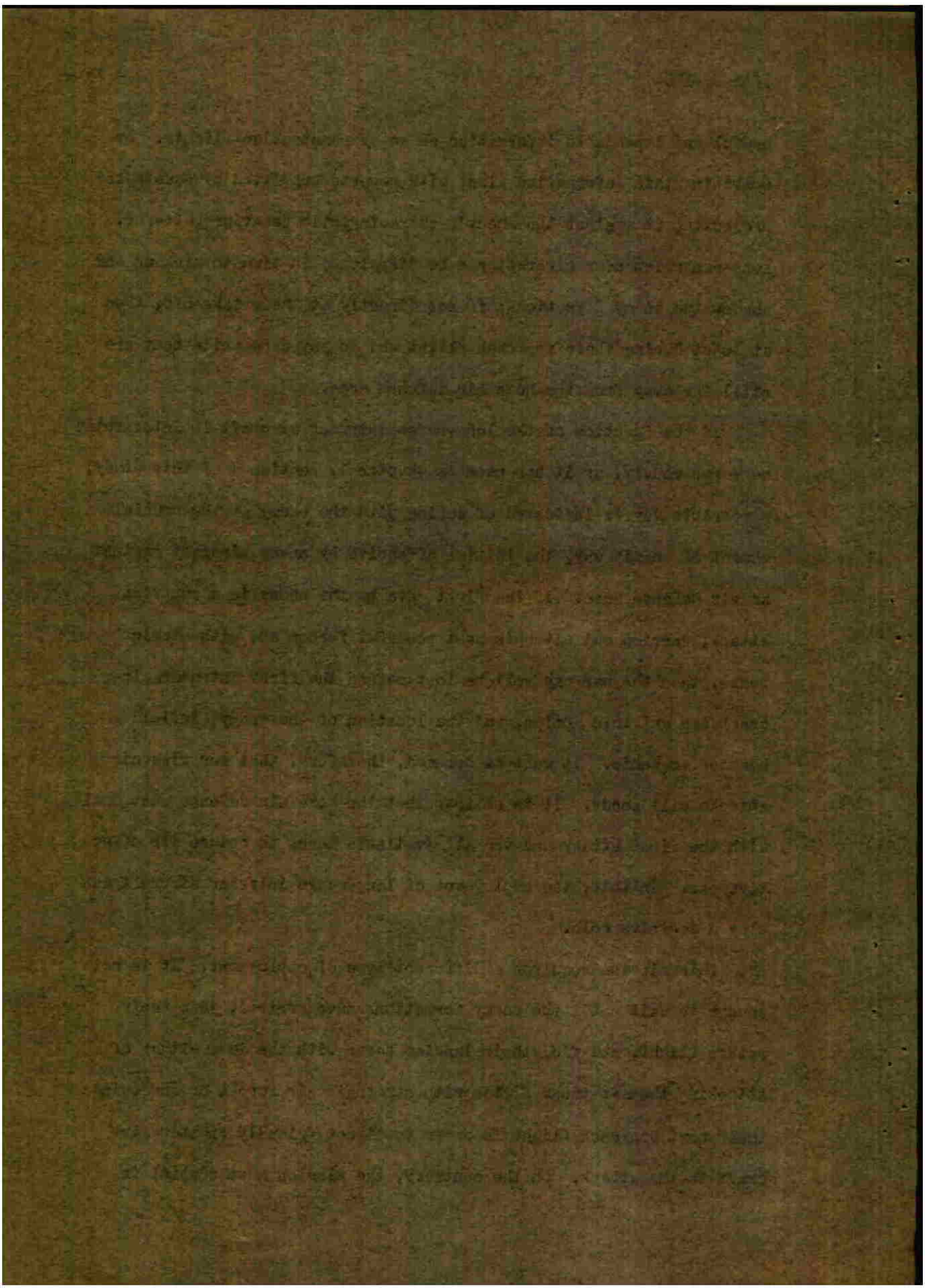
useful and dependable information on enemy penetration flights. By combining this information along with reports submitted by agents and projecting it against the enemy's characteristic behavior patterns, long-range intruder aircraft can be dispatched in time to pick up and shadow the enemy formations; if not directly at their take-off, then at least during their approach flight and in any case while they are still far away from the home air defense area.

If the function of the long-range intruder aircraft is interpreted more generously, as it has been in Chapter 1, Section I of this study, a possible way is indicated of coping with the enemy at the crucial moment of an air war, the initial offensive by enemy aircraft against an air defense area. If the first move by the enemy is a surprise attack, carried out with his most powerful forces and with atomic bombs, then the war may well be lost before the first intruder aircraft can get into action, and the location of the enemy airfield becomes academic. It must be assumed, therefore, that surprise air attacks will occur. It is obvious that the home air defense must deal with the first attack and use all available means to reduce its effectiveness. In this, the employment of long-range intruder aircraft can play a decisive role.

This mission requires a different type of employment. It is not enough to wait until the enemy formations have arrived, join their return flight, and find their landing bases with the idea either of attacking them at these fields with strategic air forces or shadowing their next approach flight in order to direct friendly fighter aircraft to the attack. On the contrary, the mission must consist in



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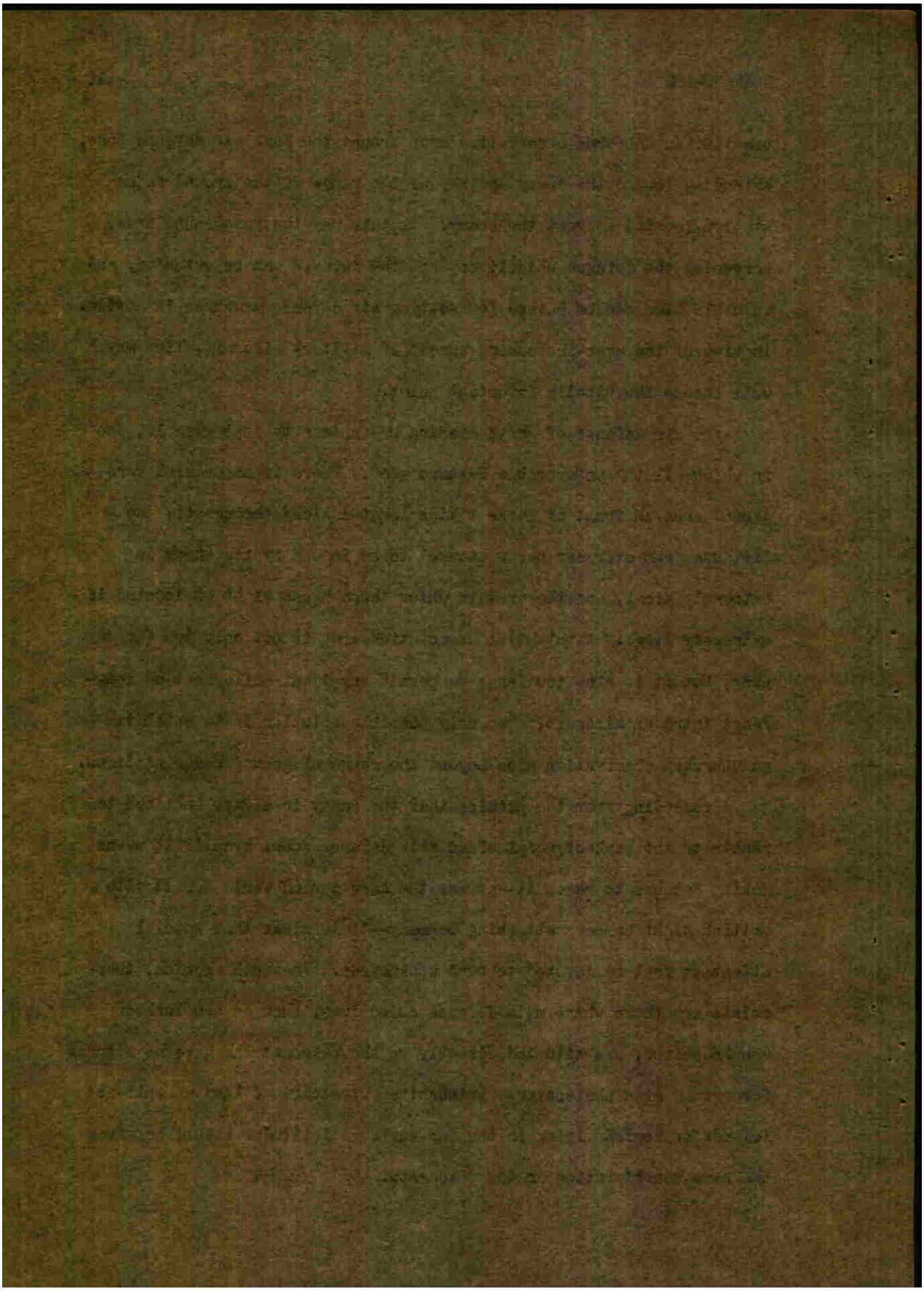
creating an unbroken observation area around the home air defense zone, extending toward the enemy and beyond the range of the ground radar station located nearest the enemy. In this way the foreground area, screening the defense objectives from the enemy, can be extended, and valuable time can be gained for setting air defense measures in motion. In view of the ever-increasing speeds of military aircraft, time may well become the vitally important point.

The air defense of North America presents a typical example, one in which all the unfavorable factors meet. There is no natural foreground area in front of large cities located along the coasts; the distance from overseas bases assumed to be in use by the enemy is extremely great, and the area in which these bases might be located is extremely large. A potential observation area is not only too far away, but it is also too large to permit any ideal employment of long-range intruder aircraft. The only possible solution is to establish an unbroken observation area beyond the range of ground radar stations.

Proceeding from the premise that the enemy is always inclined to penetrate the weakest point of an air defense zone, even if it means making detours to reach it—as was the case during World War II with British night bombers attacking Germany—it is clear that special attention must be devoted to such weaknesses. In North America, these points are those where main defense objectives, such as New York or San Francisco, are situated directly on the seacoast and have no natural foreground area whatsoever. Uninhabited stretches of land as well as islands or regions lying in the far northern latitudes should be given the same consideration as the seacoasts.



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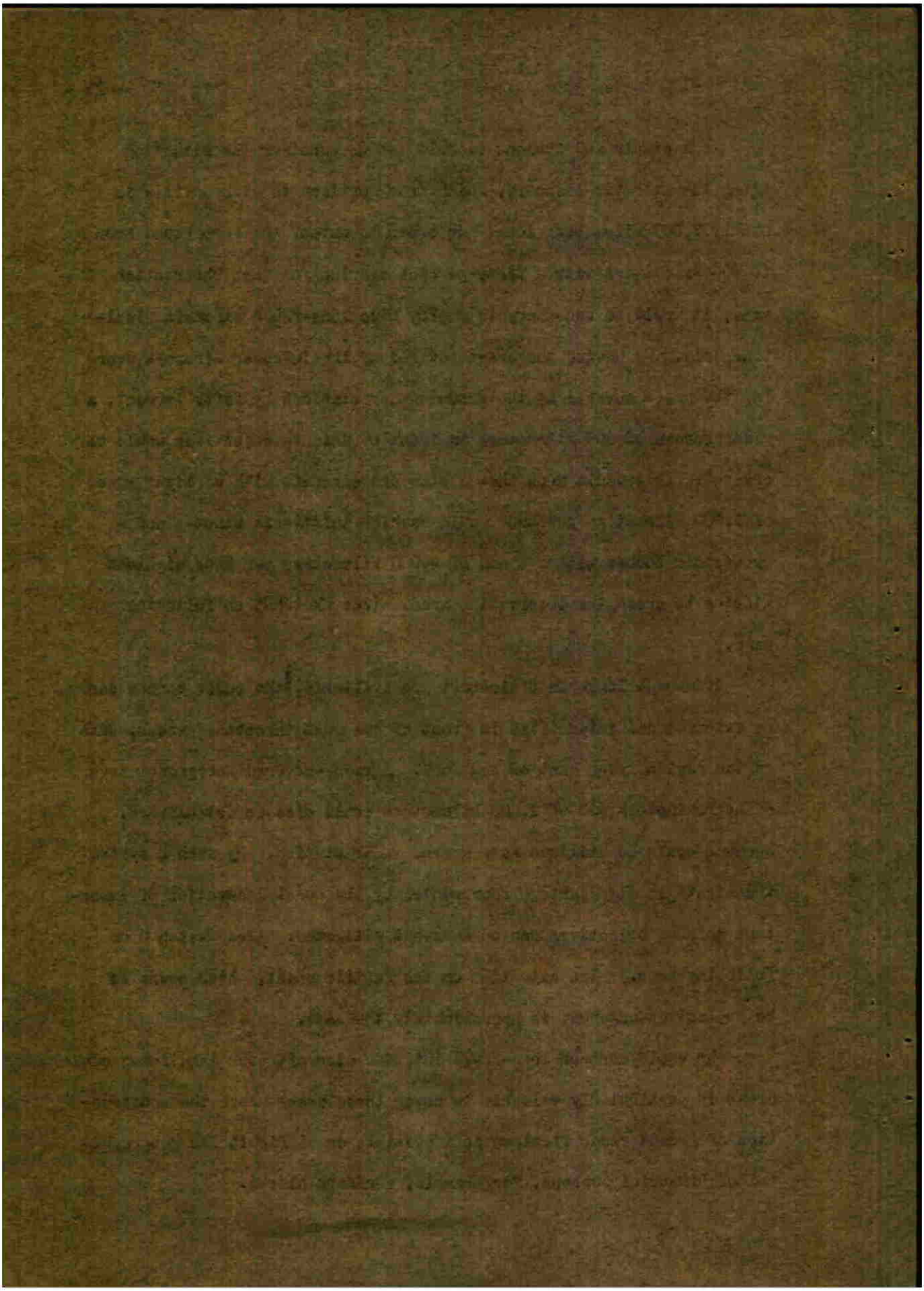
As a simple and obvious example let us consider the situation along the Atlantic seaboard, which from Portland to Jacksonville is nearly 2,000 kilometers long. In order to extend the foreground area to 600 kilometers with a fifty-percent overlap for each observation area, it would be necessary to employ five long-range aircraft simultaneously. By having the areas covered by the intruder aircraft overlap the areas covered by the ground radar stations by fifty percent, a radar screen of 600 kilometers in front of defense objectives would be created. This would mean that a standard aircraft with a flight speed of 1,000 kilometers per hour would require thirty-six minutes and a supersonic bomber with a speed of 2,000 kilometers per hour eighteen minutes to cross the observation area. (See Sketch 5 on following page.)

If enough long-range aircraft are available, the radar screen can be extended and intensified in front of the most threatened areas, such as the region lying east of New York. A radar-covered foreground area of approximately 900 or 1,200 kilometers could also be established. Bermuda could be utilized as a ground radar station. By such a system the strategic disadvantage represented by the coastal location of important defense objectives can be somewhat mitigated. (See Sketch 6 on following page.) The situation on the Pacific coast, which seems to be no less endangered, is approximately the same.

The employment of long-range intruder aircraft over land foreground areas is particularly valuable to cover those areas where the construction of ground radar stations is impossible or difficult for geographical or financial reasons, for example, northern Alaska.



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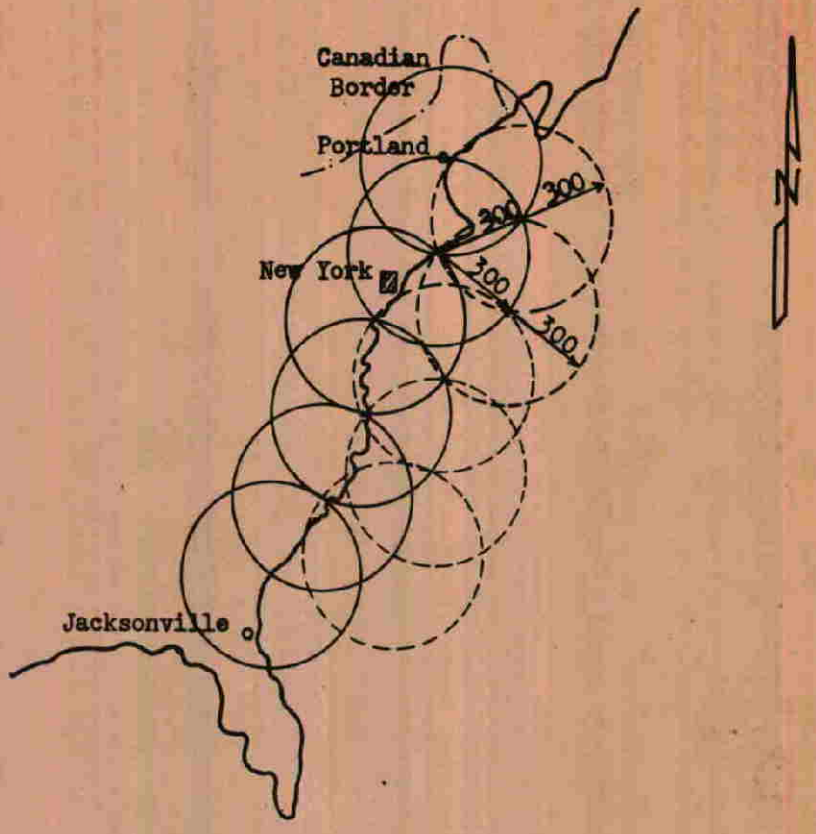
Sketch 5

THE ATLANTIC COAST FROM PORTLAND TO JACKSONVILLE

~~Foreground Area Extended to 600 Kilometers~~

By Employing Five Long-Range Aircraft



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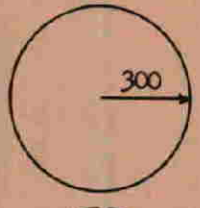
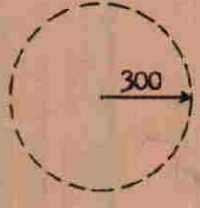


Observation areas covered by radar stations on the coast



Observation areas covered by long-range aircraft

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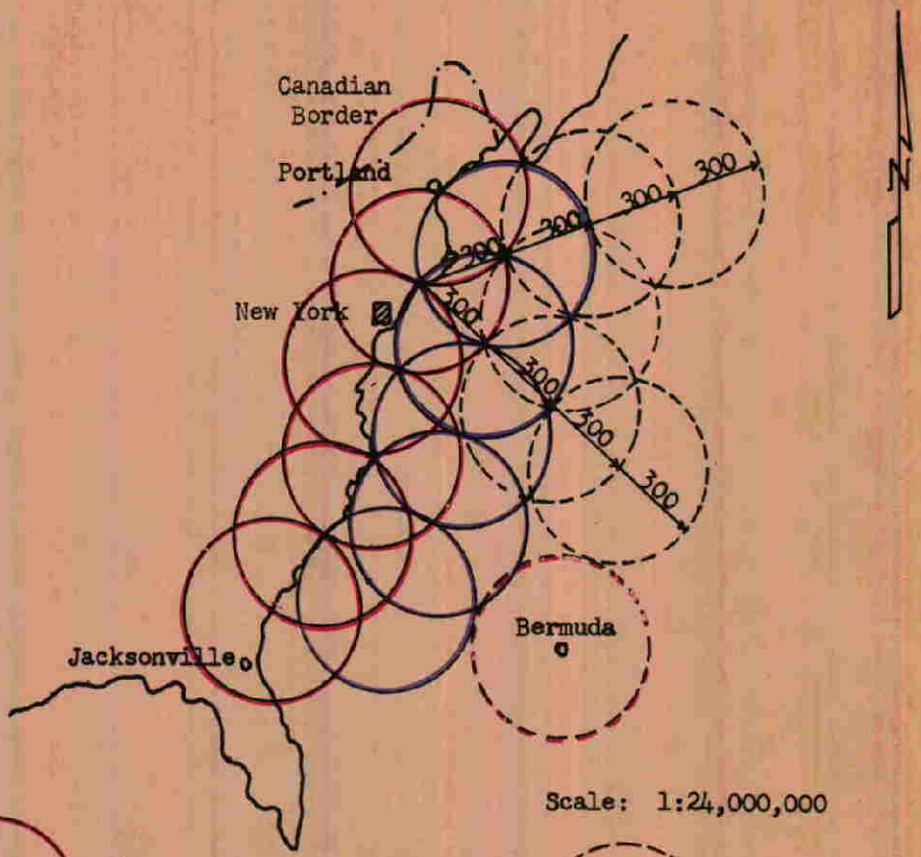
Sketch 6

THE ATLANTIC COAST FROM PORTLAND TO JACKSONVILLE

Foreground Area Extended to 1,200 Kilometers

By Employing Ten Long-Range Aircraft



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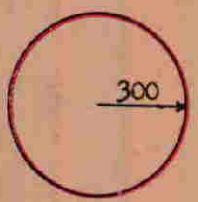
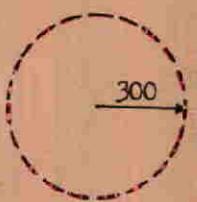
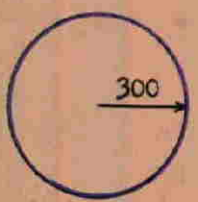


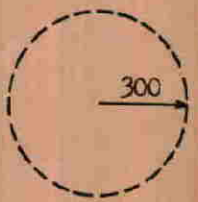
Observation areas covered by ground radar stations on the coast



Observation area covered by ground radar station on Bermuda



Observation areas covered by long-range contact aircraft

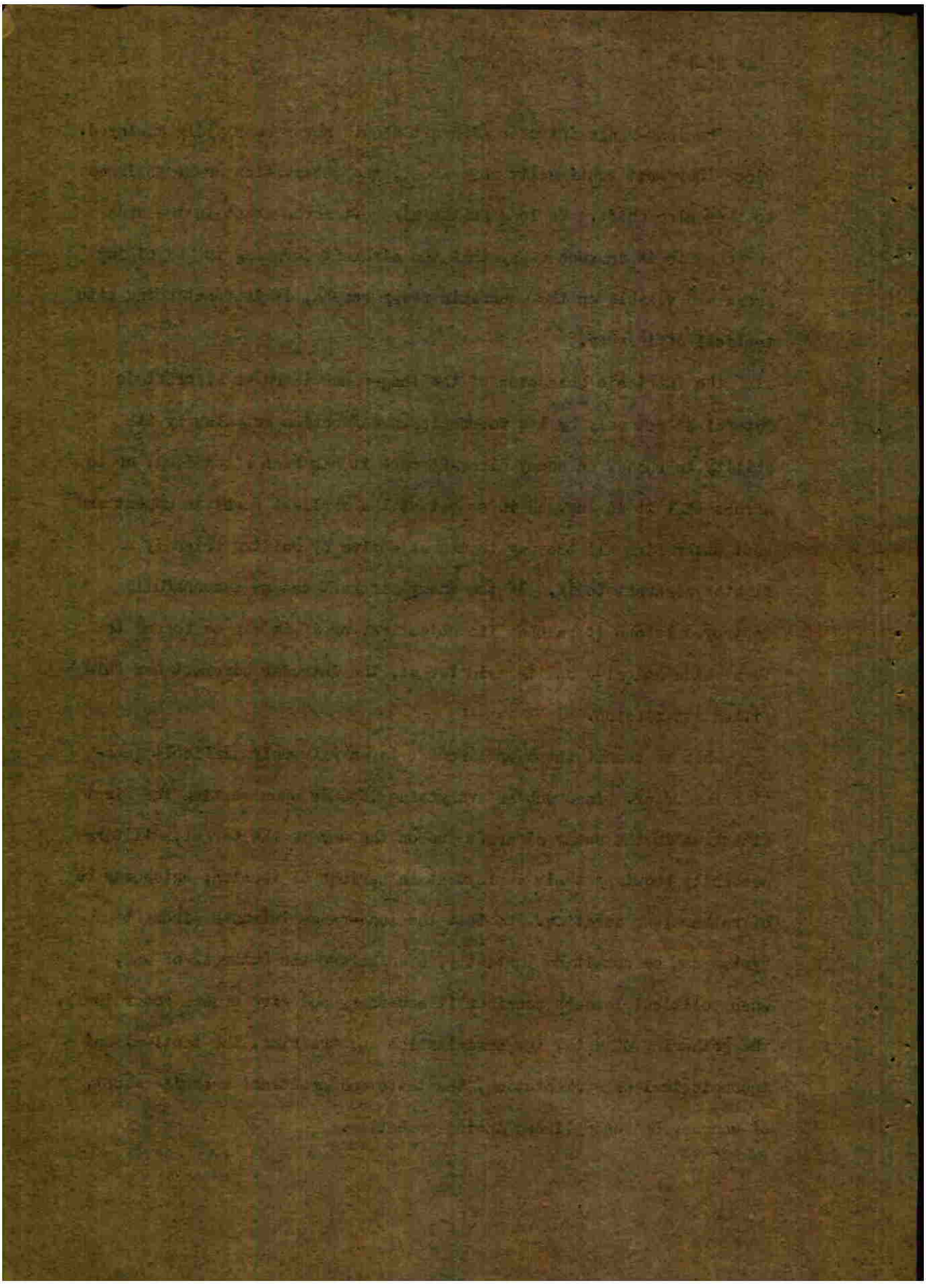


Supplementary areas serving to extend the foreground area

The long-range intruder aircraft should never be rigidly employed. Since they must continually move about, the observation areas assigned to them also shift. As long as the aircraft moves about in the area assigned to it in such a way that the aircraft covering the adjoining areas are visible on the panoramic radar screen, it is functioning with tactical efficiency.

The intrinsic character of the long-range intruder aircraft is determined not only by its reconnaissance function but also by its ability to shadow an enemy aircraft once it has been recognized, or to assure that it is engaged in combat at the earliest possible moment and kept under fire all the way to its objective by guiding friendly fighter aircraft to it. If the enemy aircraft can be successfully destroyed before it reaches its objective, or if it can be forced to turn aside and give up its main target, the intruder aircraft has fulfilled its mission.

When to commit intruder aircraft is an extremely difficult question to answer. Inasmuch as everything depends upon meeting the first attack while the enemy aircraft are on the way to the target, military necessity requires their employment in periods of tension, which may be of rather long duration. So that the long-range intruder aircraft system can be committed instantly, even before the outbreak of war, when political leaders consider it necessary and give orders accordingly, the gathering of data, the organization and training, the tactical and technological experimentation, the tests and practical exercises must, of course, be accomplished during peacetime.



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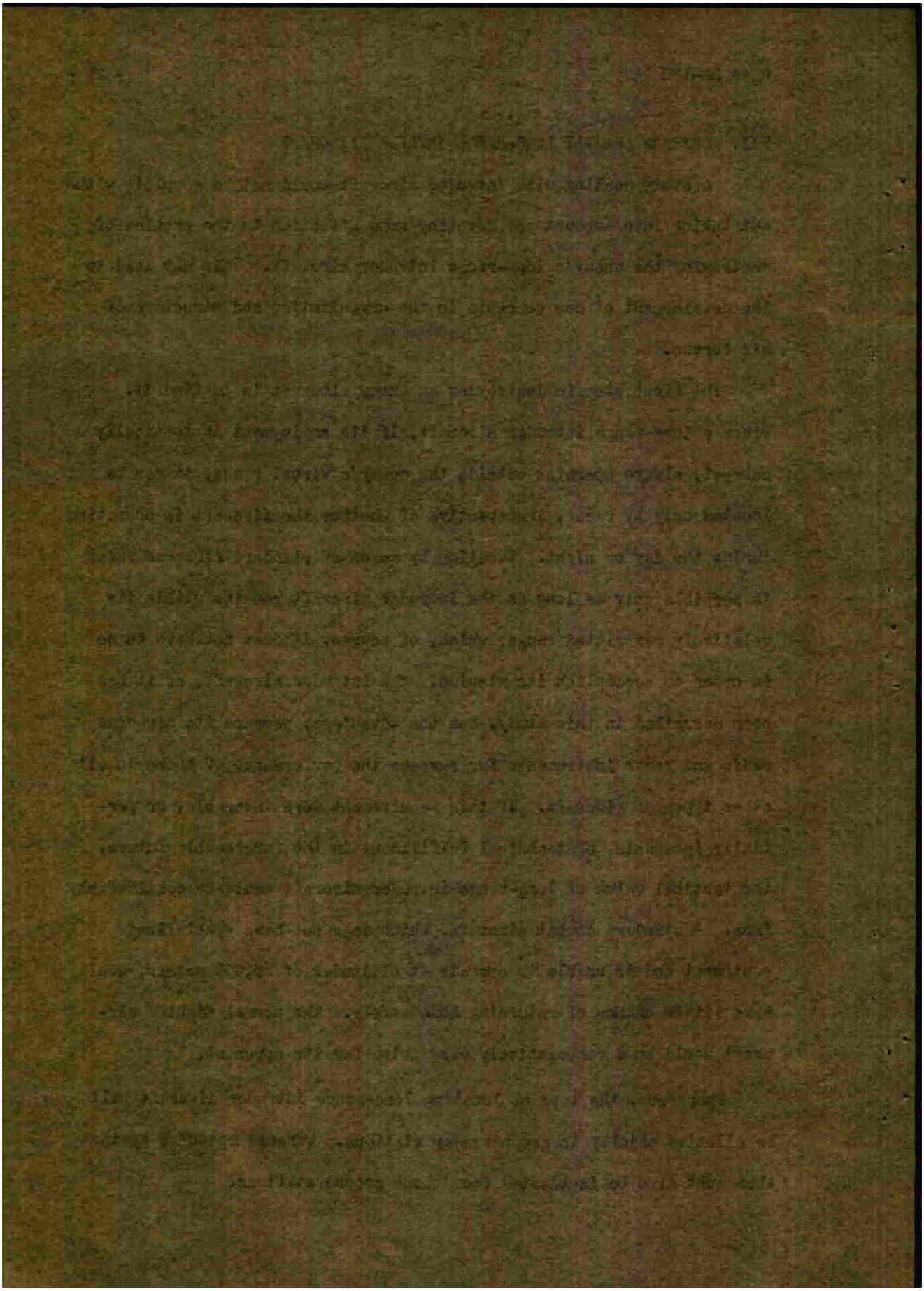
VII. DEFENSE AGAINST LONG-RANGE INTRUDER AIRCRAFT

A study dealing with intruder aircraft would not be complete without taking into account and devoting some attention to the problem of destroying the enemy's long-range intruder aircraft. This may lead to the development of new concepts in the organization and structure of air forces.

The first step in destroying an enemy aircraft is to find it. Since a long-range intruder aircraft, if its employment is tactically correct, always operates outside the enemy's visual range, it can be located only by radar, irrespective of whether the aircraft is operating during the day or night. Location by means of standard airborne radar is possible only as long as the intruder aircraft remains within its relatively restricted range, which, of course, it does not have to do in order to accomplish its mission. The intruder aircraft, as it has been described in this study, has the advantage, because its airborne radio and radar instruments far surpass the performance of those in all other types of aircraft. If this requirement were incapable, or partially incapable, of technical fulfillment in the foreseeable future, the tactical value of long-range intruder aircraft would be considerably less. A standard combat aircraft, which does not have specialized equipment and is unable to operate at altitudes of 20,000 meters, would have little chance of returning home safely. The normal fighter aircraft would be a comparatively easy prize for its opponent.

Therefore, the task of locating long-range intruder aircraft will be allotted chiefly to ground radar stations. Defense measures against them must also be instigated from these ground stations.



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As has already been pointed out, the employment of ordinary day, night, or all-weather fighter aircraft promises little. Rocket-driven interceptor aircraft, such as the German Lippisch Me 163 or the Bachem Natter,[7] have better prospects of success, but again there is the disadvantage that their field of action will always be fairly limited. It would be possible to station them on all occupied airfields to shoot down enemy intruder aircraft which fly over or near these airfields, but an intruder aircraft does not have to operate over or near an airfield in order to fulfill its mission, since it is not forced to depend on naked-eye vision. Rocket-driven interceptors, then, could be used only if the enemy made a tactical error in the employment of its intruder aircraft. It can happen, of course, that one might accidentally fly over or near an occupied air base because it operates within a 300-kilometer radius of it. In that case an interceptor might well be fortunate enough to shoot it down, because its presence in the observation area can remain undetected only if the ground radar has been put out of action.

The best prospects for success seem to lie in using highly efficient heavy antiaircraft rocket units, which in any case are the best suited to employment in home air defense operations.[8]

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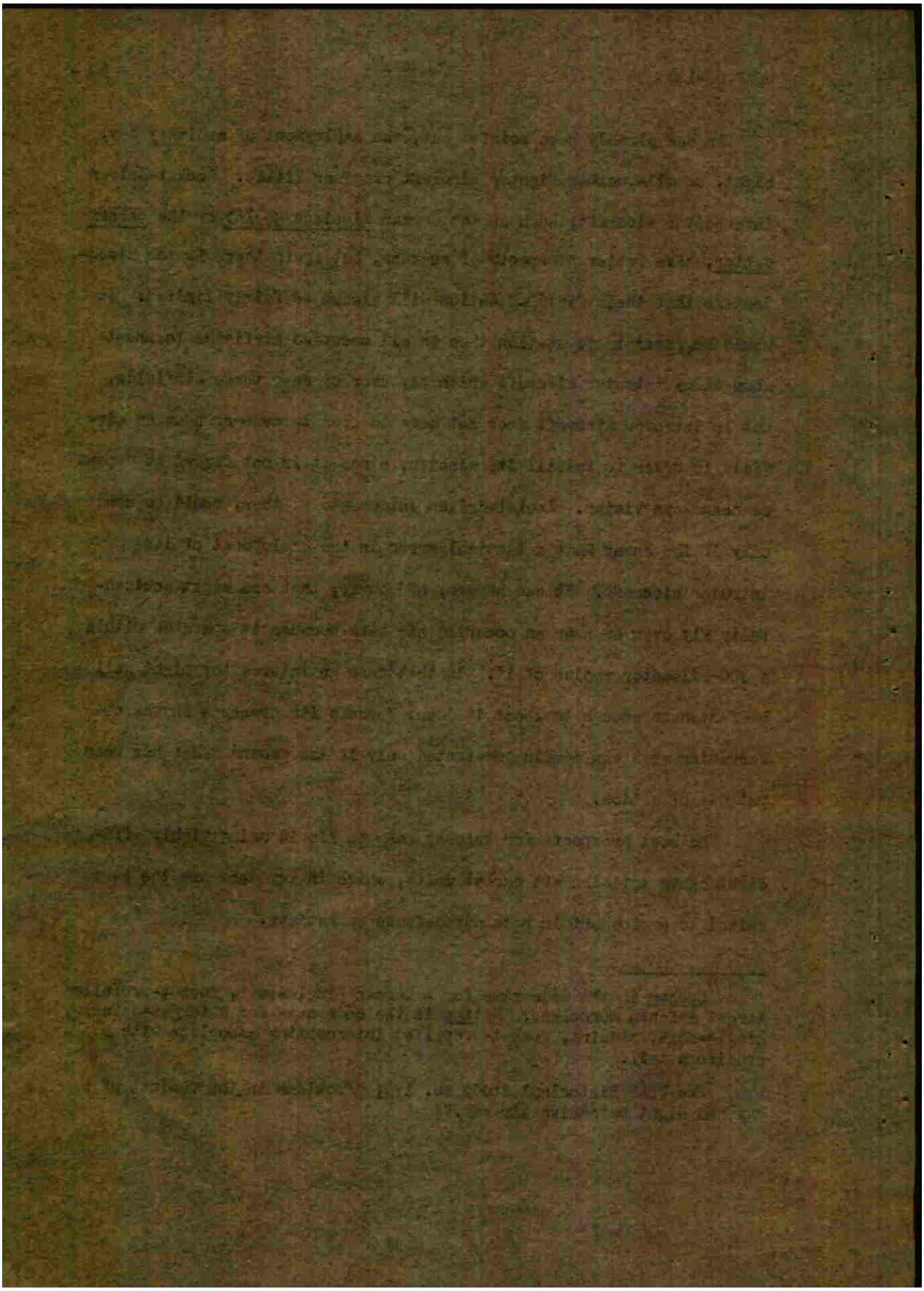
[7] Bachem is the code name for a German single-seat, rocket-propelled target defense monoplane. Natter is the code name for a target-defense, single-seat, midwing, rocket-propelled intercepting monoplane with a cruciform tail.

[8] See USAF Historical Study No. 179, "Problems in the Conduct of a Day and Night Defensive Air War."



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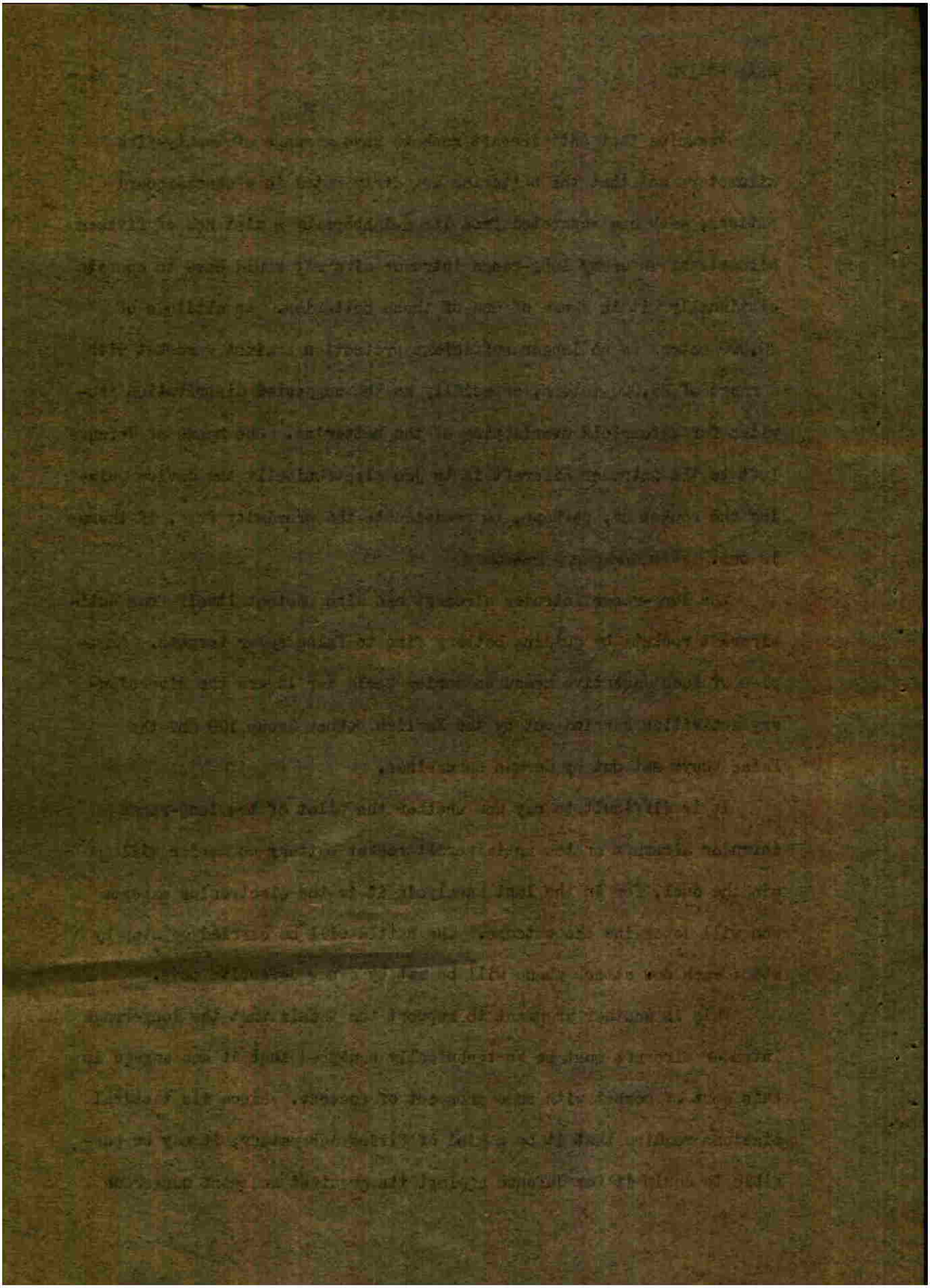
Assuming that antiaircraft rockets have a range of twenty-five kilometers and that the batteries are distributed in a checkerboard pattern, each one separated from its neighbors by a distance of fifteen kilometers, an enemy long-range intruder aircraft would have to operate continually within range of one of these batteries. An altitude of 20,000 meters is no longer sufficient protection against a rocket with a range of 25,000 meters, especially as the suggested distribution provides for a fourfold overlapping of the batteries. One means of defense left to the intruder aircraft is to jam electronically the device guiding the rocket or, perhaps, to predetonate the proximity fuse, if there is one.

The long-range intruder aircraft can also protect itself from antiaircraft rockets by guiding battery fire to false radar targets. Examples of such deceptive measures during World War II are the diversionary activities carried out by the English Bomber Group 100 and the false buoys set out by German submarines.

It is difficult to say now whether the pilot of the long-range intruder aircraft or the antiaircraft rocket battery commander will win the duel, for in the last analysis it is the electronics experts who will determine the outcome. The battle will be carried on step by step; each new attack phase will be met by a new defensive move.

This is another argument to support the thesis that the long-range intruder aircraft must be so technically equipped that it can engage in this sort of combat with some prospect of success. Since its tactical missions require that it be a kind of flying laboratory, it may be possible to equip it for defense against its greatest and most dangerous



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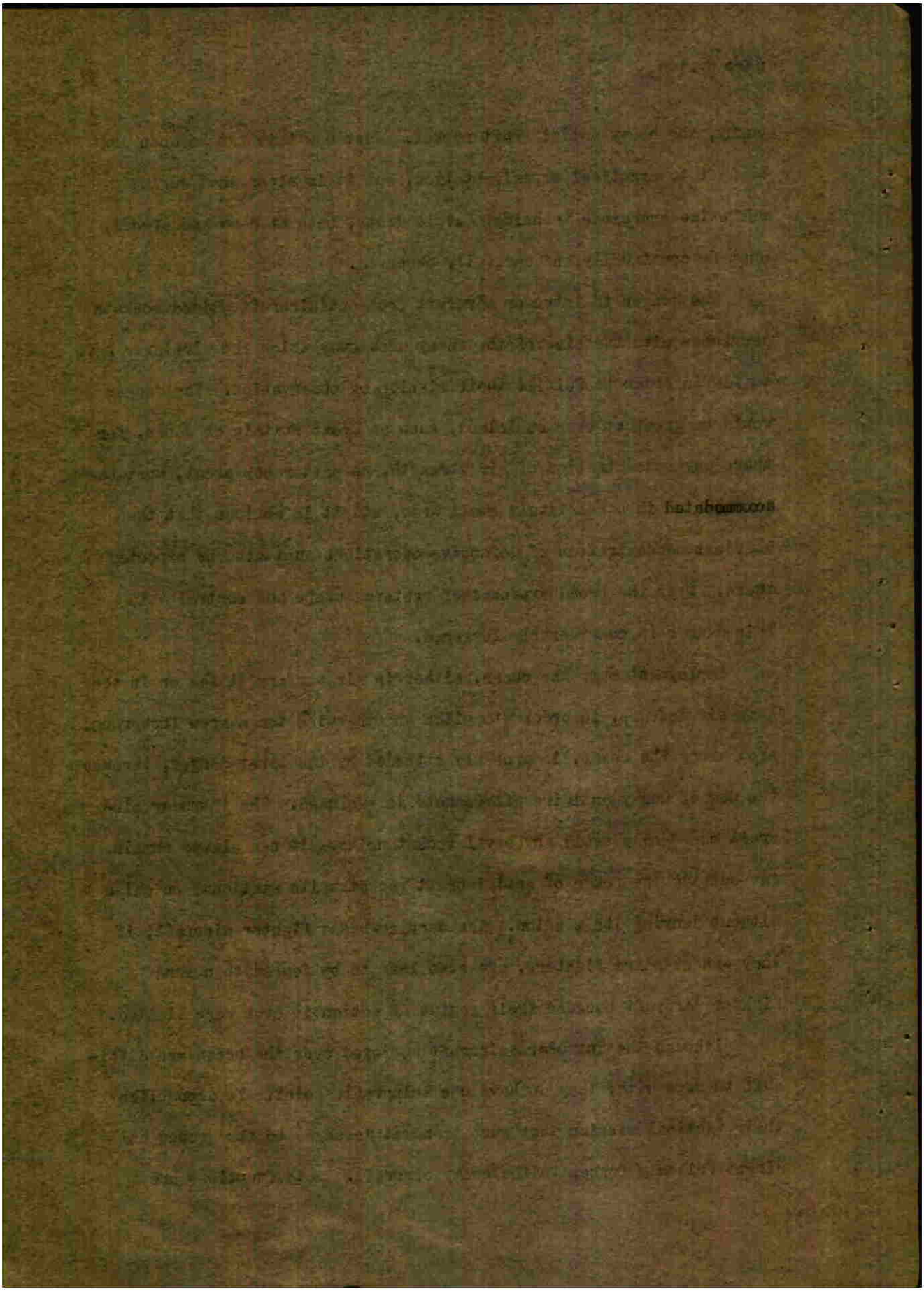
enemy, the heavy antiaircraft rocket. Just how this can be done must be left to practical experimentation, but it is clear that during peacetime exercises technical developments, both at home and abroad, must be continually and carefully observed.

The danger to intruder aircraft from antiaircraft guided rockets decreases with the size of the enemy area over which the airplanes have to fly in order to fulfill their mission of observation. The danger would be greatest over an island, such as Great Britain or Japan, for there any concentration of air strength, no matter how great, must be accommodated in a relatively small area, and it is obvious that the heaviest concentration of defensive operations must also be expected there. Over the broad expanses of eastern Europe and central Asia this danger is considerably lessened.

Employment over the ocean, either in air warfare at sea or in the home air defense, in order to widen an otherwise too narrow foreground area along the coast, is probably attended by the least danger, because the use of heavy antiaircraft rockets is excluded. The intruder aircraft can easily avoid any naval rocket units. It can always remain far outside the range of antiaircraft rocket units stationed on ships without denying its mission. The carrier-based fighter aircraft, if they are standard fighters, are even less to be feared than land fighter aircraft because their radius of action is even more limited.

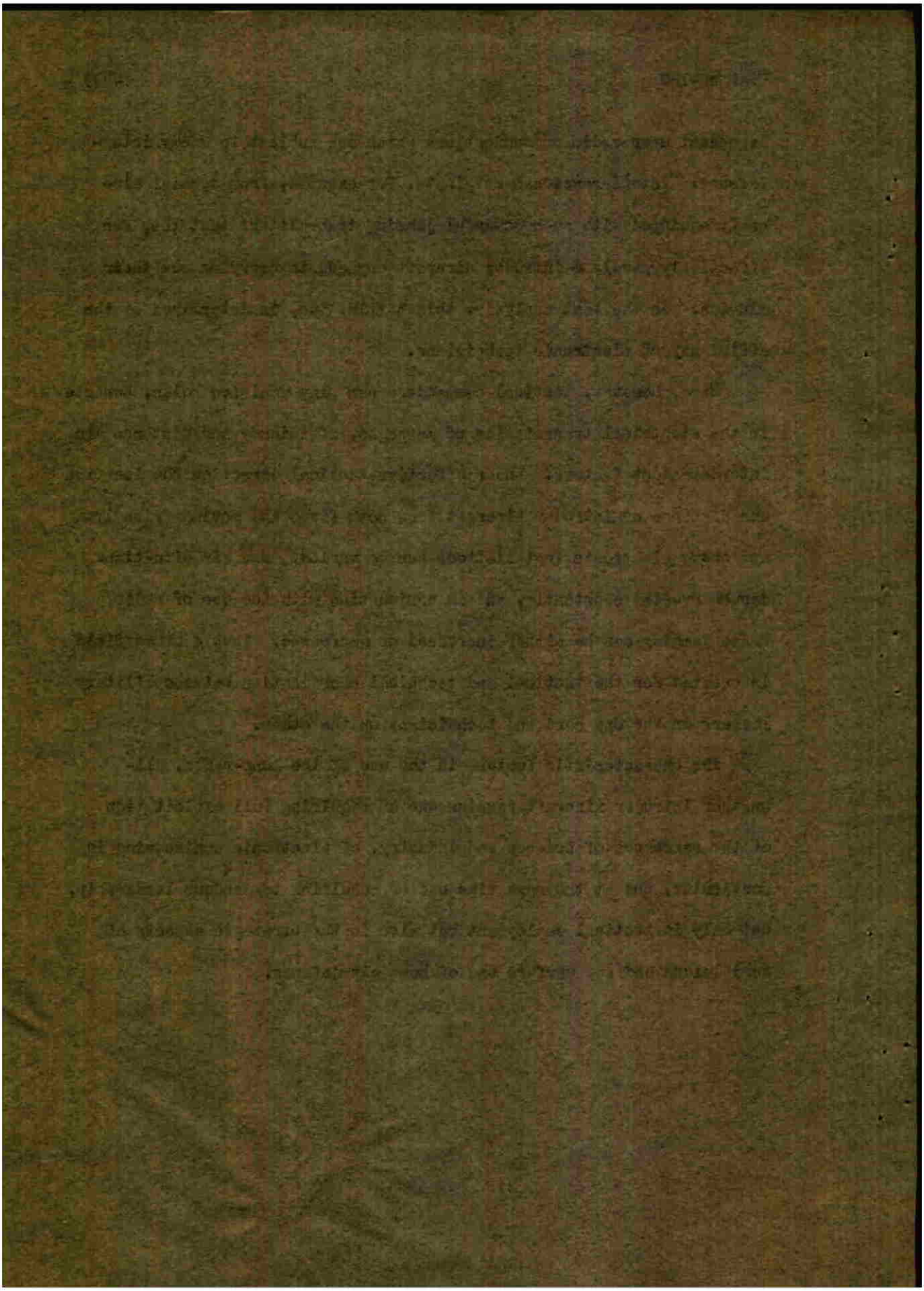
Although the intruder aircraft employed over the ocean are difficult to cope with, they do have one vulnerable point. To accomplish their tactical mission they must transmit messages to the ground and direct friendly forces to the enemy aircraft. Both functions are



dependent upon radio communications which are subject to enemy interference. Interference can originate, for example, from special aircraft equipped with such powerful jamming transmitters that they can effectively paralyze intruder aircraft engaged in carrying out their mission. In the last analysis, this battle, too, is determined by the efficiency of electronic technicians.

Here, however, tactical commanders can play decisive roles, because in the electrical transmission of messages, efficiency and distance are interdependent factors. Under effective tactical direction the location and distance of intruder aircraft from both fixed and moving friendly and enemy electronic installations can be varied. New air situations can be created constantly, and in conjunction with the use of radio beams jamming can be either increased or decreased. Thus a broad field is created for the tactical and technical coordination between military leaders on the one hand and technicians on the other.

The characteristic feature in the use of the long-range, all-weather intruder aircraft remains one of requiring full exploitation of the resources of science and industry, of electronic engineering in particular, and at the same time one of requiring tremendous leadership, not only in tactical employment but also in the strategic aspects of aerial land and sea warfare and of home air defense.



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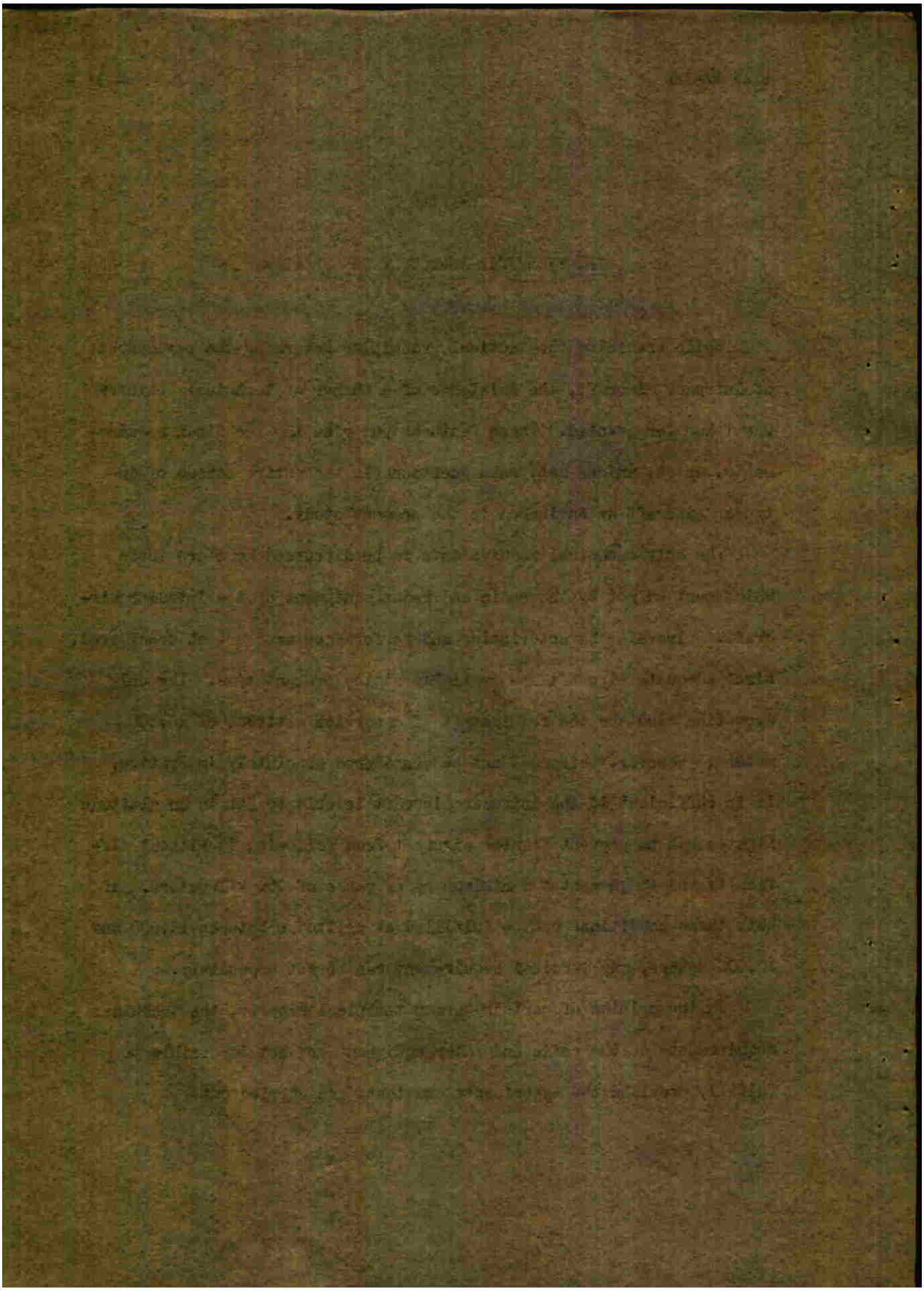
CHAPTER 2

THE TECHNICAL ASPECT OF THE PROBLEM

While examining the tactical principles governing the employment of intruder aircraft, the existence of a number of technical features was taken for granted. These features comprise the technical requirements, which, unless met, make questionable the entire scheme of intruder aircraft as envisaged in the present study.

The only technical requirements to be discussed here are those which must be met by the radio and radar equipment of the intruder aircraft. Aircraft characteristics and performance need not be considered, since adequate aircraft are available at the present time. The only exception might be the requirement of a service altitude of 20,000 meters. However, this need not be considered absolutely imperative. It is sufficient if the intruder aircraft is able to attain an altitude high enough to prevent fighter aircraft from following it without difficulty and to guarantee a minimum radar range of 300 kilometers. If both these conditions can be fulfilled at altitudes between 15,000 and 20,000 meters, any tactical requirement can be met adequately.

In the opinion of certain German technical experts, the technical requirements of the radio and radar equipment are not impossible to fulfill, provided the experiments and tests are carried out



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systematically.[1] As far as they can see, ways and means can be found to overcome any technical difficulties which stand in the way of the necessary tactical requirements.

I. AIRBORNE PANORAMIC RADAR

The entire reason for long-range, all-weather intruder aircraft lies in its airborne radar, which alone enables it to shadow enemy air or naval forces beyond visual range. The longer the range of its radar, the greater the value of the intruder aircraft. In view of this fact it would be wise to strive for a radar range of 500 kilometers or more.

At the present time such a radar does not exist, and the most practical solution at the moment is to aim for a range already attainable on the ground, 300 kilometers, with a wave length of three centimeters. If a ground radar could be built into an aircraft, carried to an appropriate altitude, and focused on the targets, it is theoretically possible to develop the same range as the set has on the ground and probably even more. Whether this assumption is true, and what deviations from it might be encountered, can be proved only by practical experimentation.

In order to secure a complete picture of the air situation, the airborne search instrument must be of the panoramic type, that is, it must have a revolving antenna. No matter how large the aircraft may be, certain difficulties will be encountered in installing such an

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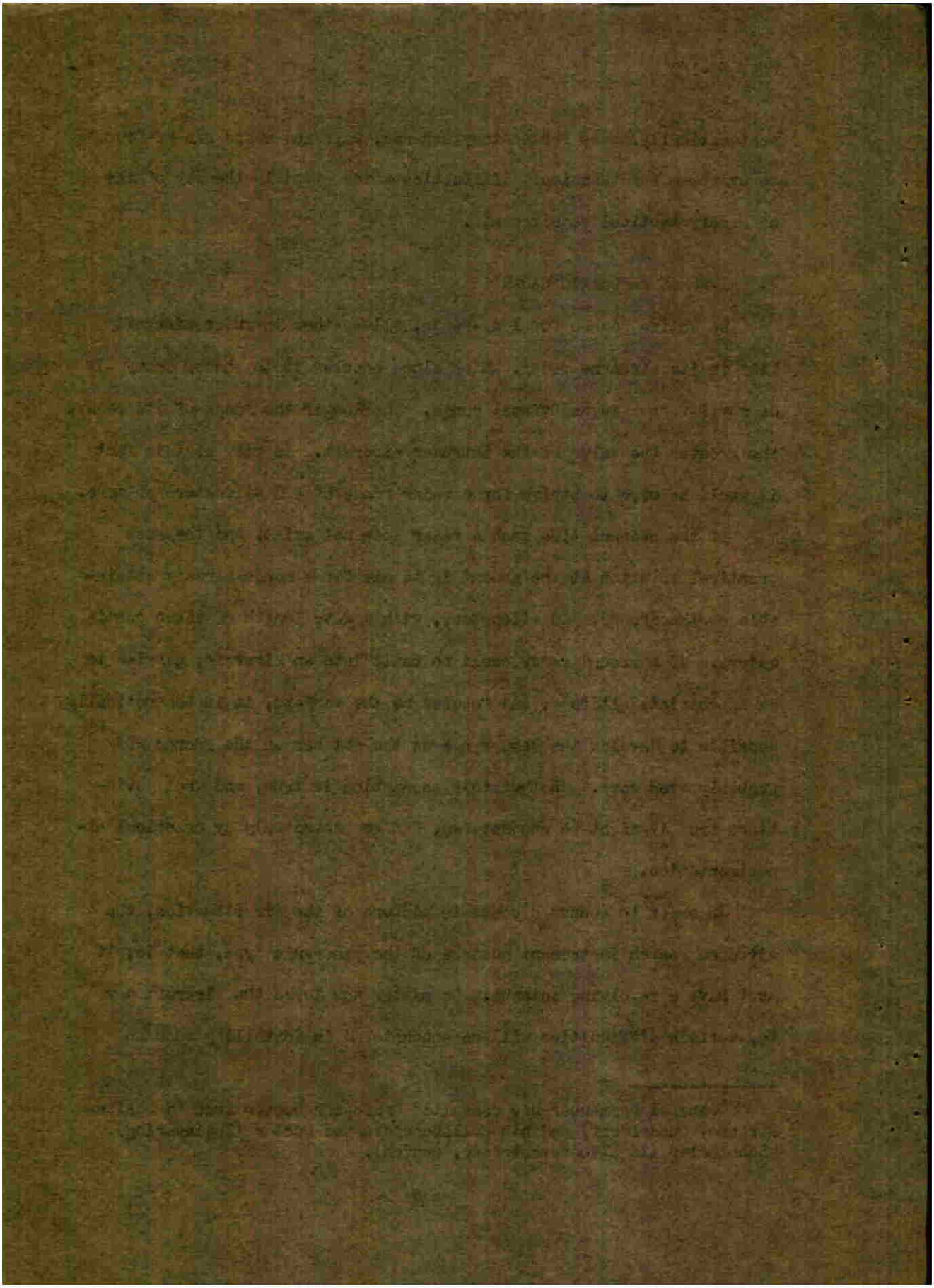
[1] General Kammhuber has consulted Professor Doctor Esau (5 Schlossstrasse, Duesseldorf) and his collaborators and Doctor (Engineering) Pichelmaier (18 Aldegrevestrasse, Munich).



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apparatus. Since the antenna must be kept as small as possible, the shortest practicable wave length must be selected. Whether this can be done without running into the considerable difficulties occasioned by absorption of water vapor and by reflection is also a question which can be answered only by detailed, practical experiments.

II. AIRBORNE RADIO

Once the intruder aircraft has determined the location of the enemy's air or naval base, the next step depends upon whether the intruder aircraft is being employed in land or sea strategic air warfare or in home air defense.

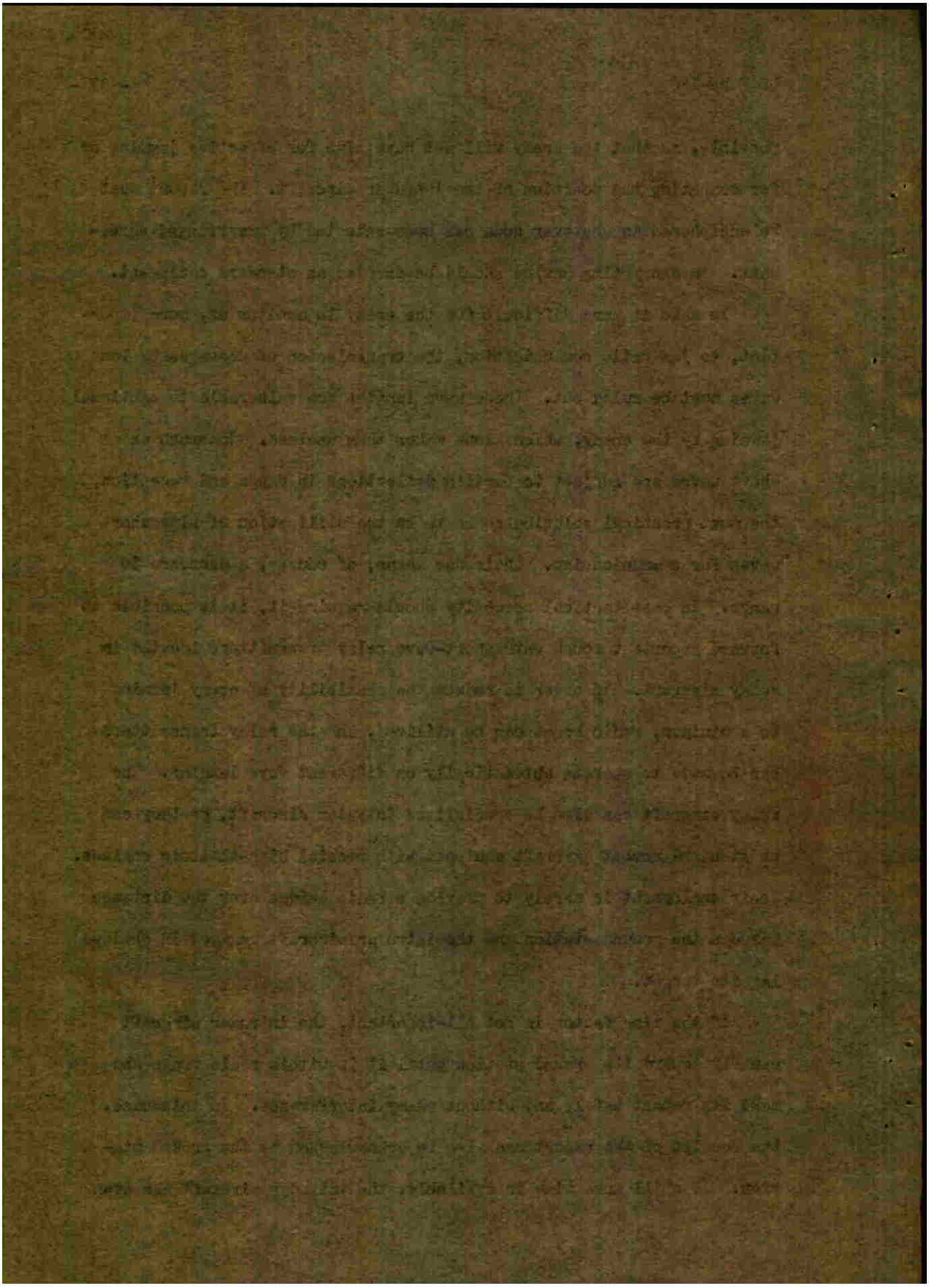
In the first case, it may be of the greatest tactical importance to communicate its information as quickly and as exactly as possible to the proper air force ground installation, so that an attack may be launched after the enemy has landed and while he is unprepared and engaged in refueling, loading ammunition, feeding and resting personnel, and servicing aircraft. Depending upon the distance of the enemy air base the transmission of vitally important information involves not only the usual problem of range but also the problem of maintaining secrecy, which in turn is concerned with the vulnerability of airborne radio equipment to enemy jamming.

An intruder aircraft must maintain strict radio silence as long as it is engaged in shadowing its objective, but once the enemy forces have landed, tactical considerations force the intruder aircraft to break its radio silence and report. Because this is bound to attract the notice of a watchful enemy, the report must be kept as brief as

possible, so that the enemy will not have time for effective jamming or for computing the position of the intruder aircraft. The report must be enciphered in whatever code has been selected by prearranged agreement. An encrypting device should be carried as standard equipment.

To make it more difficult for the enemy to monitor or, more important, to jam radio communication, the transmission of messages by long waves must be ruled out. These wave lengths are vulnerable to continual jamming by the enemy, which alone makes them useless. Inasmuch as short waves are subject to certain deflections in range and reception, the most practical solution seems to be the utilization of ultrashort waves for communication. Their use means, of course, a decrease in range. In case tactical necessity should require it, it is possible to forward reports through untrashort-wave relay transmitters located in relay aircraft. In order to reduce the possibility of enemy jamming to a minimum, radio beams can be utilized, and the relay transmitters can be made to operate automatically on different wave lengths. The relay aircraft can also be specialized intruder aircraft, or they can be standard combat aircraft equipped with special high-altitude engines. Their employment is merely to provide a radio bridge over the distance between the ground station and the intruder aircraft engaged in shadowing its target.

If the time factor is not all-important, the intruder aircraft can fly toward its ground station until it is within radio range and make its report safely and without enemy interference. In this case, the receipt of the report can also be acknowledged by the ground station. If still more time is available, the intruder aircraft can even



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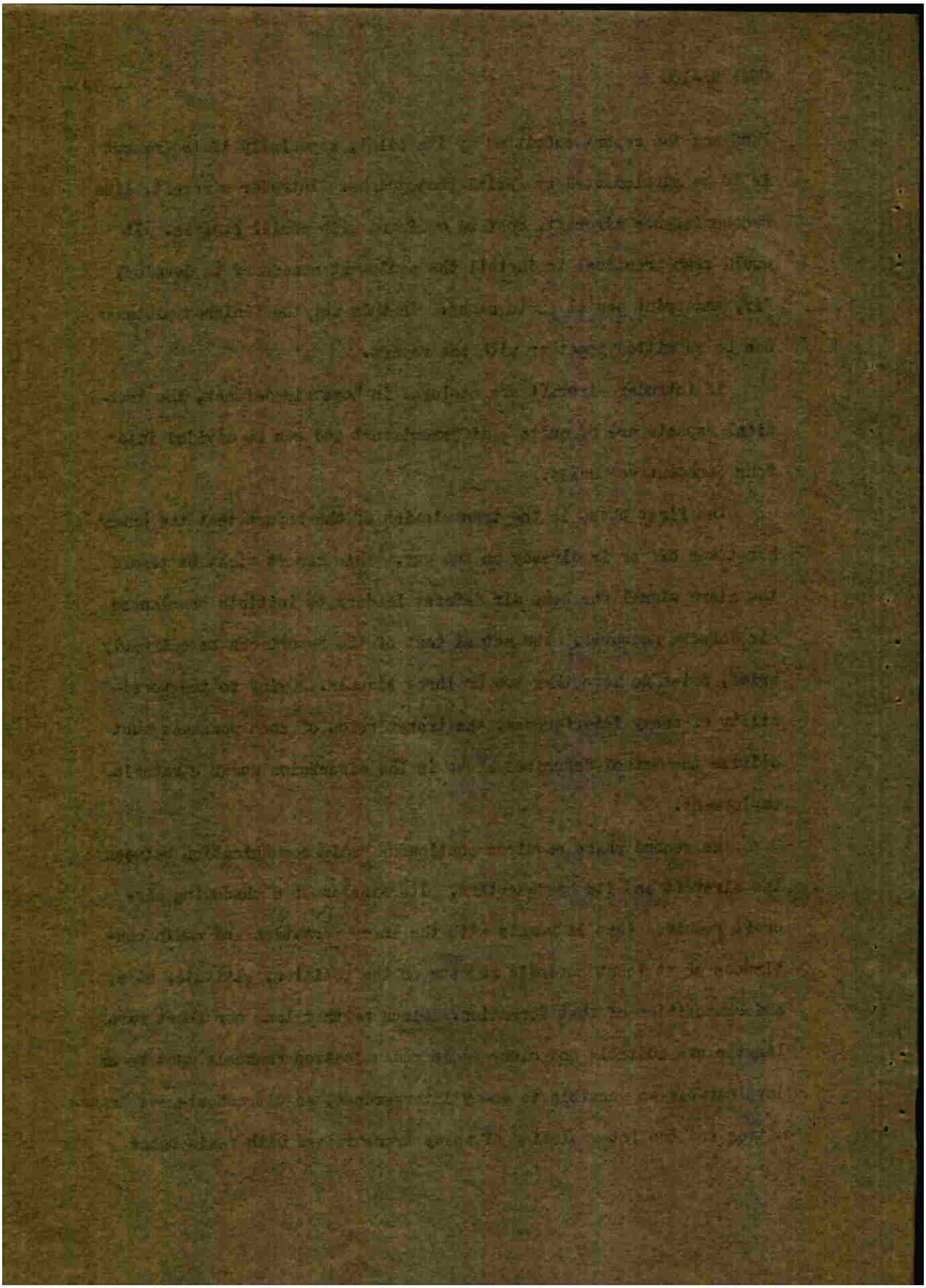
land and the report submitted by its pilot, especially if the report is to be supplemented by aerial photographs. Intruder aircraft, like reconnaissance aircraft, must be equipped with aerial cameras. It would seem practical to install the equipment necessary to develop, fix, and print aerial photographs. In this way the finished pictures can be submitted together with the report.

If intruder aircraft are employed in home air defense, the technical aspects are of quite a different sort and can be divided into four consecutive phases.

The first phase is the transmission of the report that the enemy has taken off or is already on the way. This report might be termed the alarm signal for home air defense leaders to initiate preplanned air defense measures. The actual text of the report can be extremely brief, often no more than two or three signals. Owing to the possibility of enemy interference, the transmission of such messages must utilize the method described above in the discussion under strategic employment.

The second phase requires continuous radio communication between the aircraft and its headquarters. Its mission as a shadowing aircraft requires that it remain with the enemy formation and radio continuous or at least periodic reports on the position, altitude, size, and composition of that formation. Since neither long nor short wave lengths are suitable and since radio communication channels must be as invulnerable as possible to enemy interference, an ultrashort-wave transmitter and the interpolation of relay transmitters with radio beams



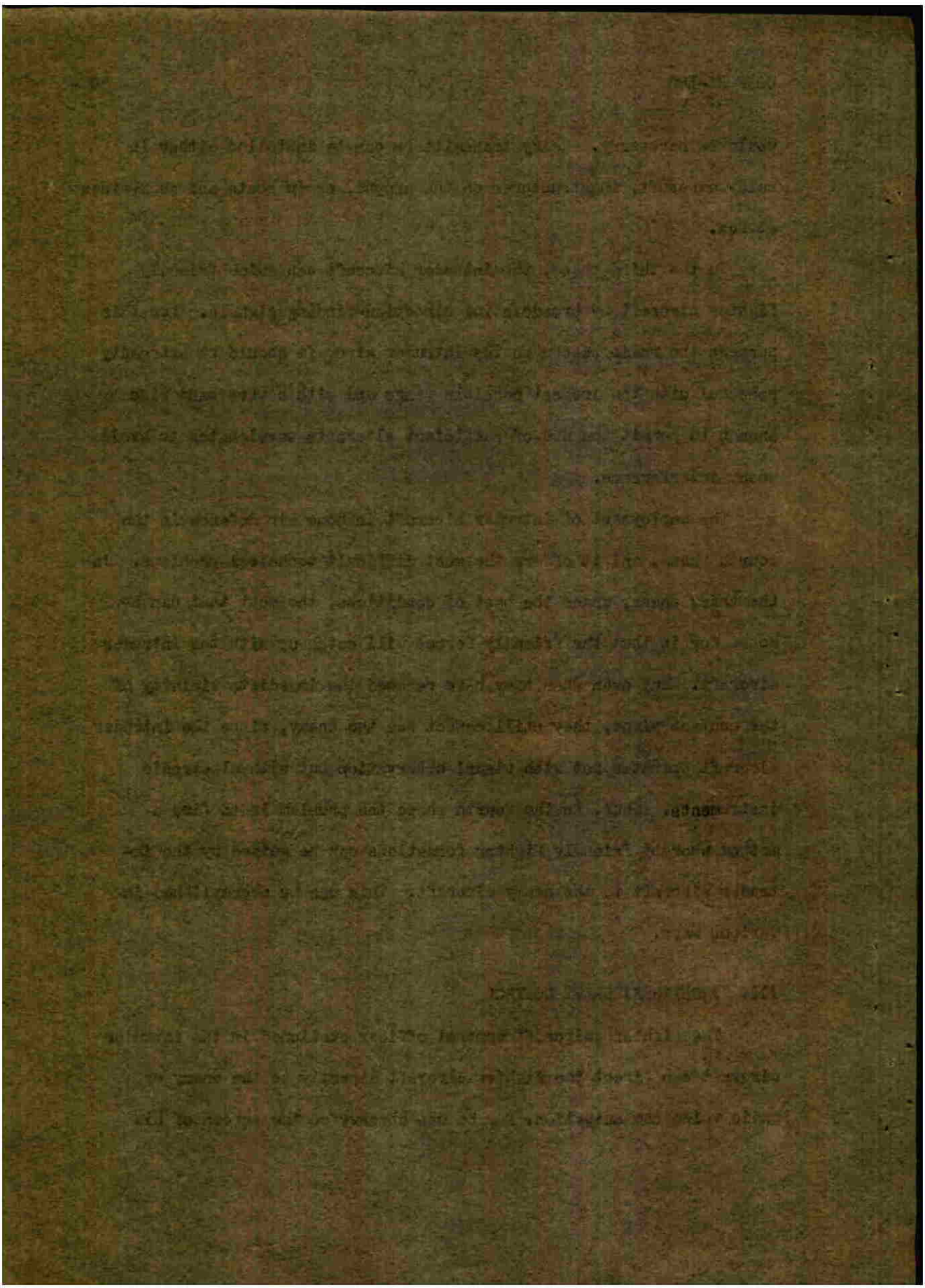
would be necessary. Relay transmitters can be installed either in relay aircraft, in structures on the ground, or in boats and submarines at sea.

In the third phase, the intruder aircraft can guide friendly fighter aircraft by broadcasting direction-finding signals. For this purpose the radio beacon on the intruder aircraft should be extremely powerful with the longest possible range and with a wave band wide enough to permit the use of sufficient alternate wavelengths to avoid enemy interference.

The employment of intruder aircraft in home air defense is the fourth phase, and it offers the most difficult technical problems. In the third phase, under the best of conditions, the most that can be hoped for is that the friendly forces will catch up with the intruder aircraft. But even when they have reached the immediate vicinity of the contact plane, they still cannot see the enemy, since the intruder aircraft operates not with visual observation but with electronic instruments. Thus, in the fourth phase the problem is to find a method whereby friendly fighter formations can be guided by the intruder aircraft to the enemy aircraft. This can be accomplished in various ways.

III. FIGHTER AIRCRAFT CONTROL

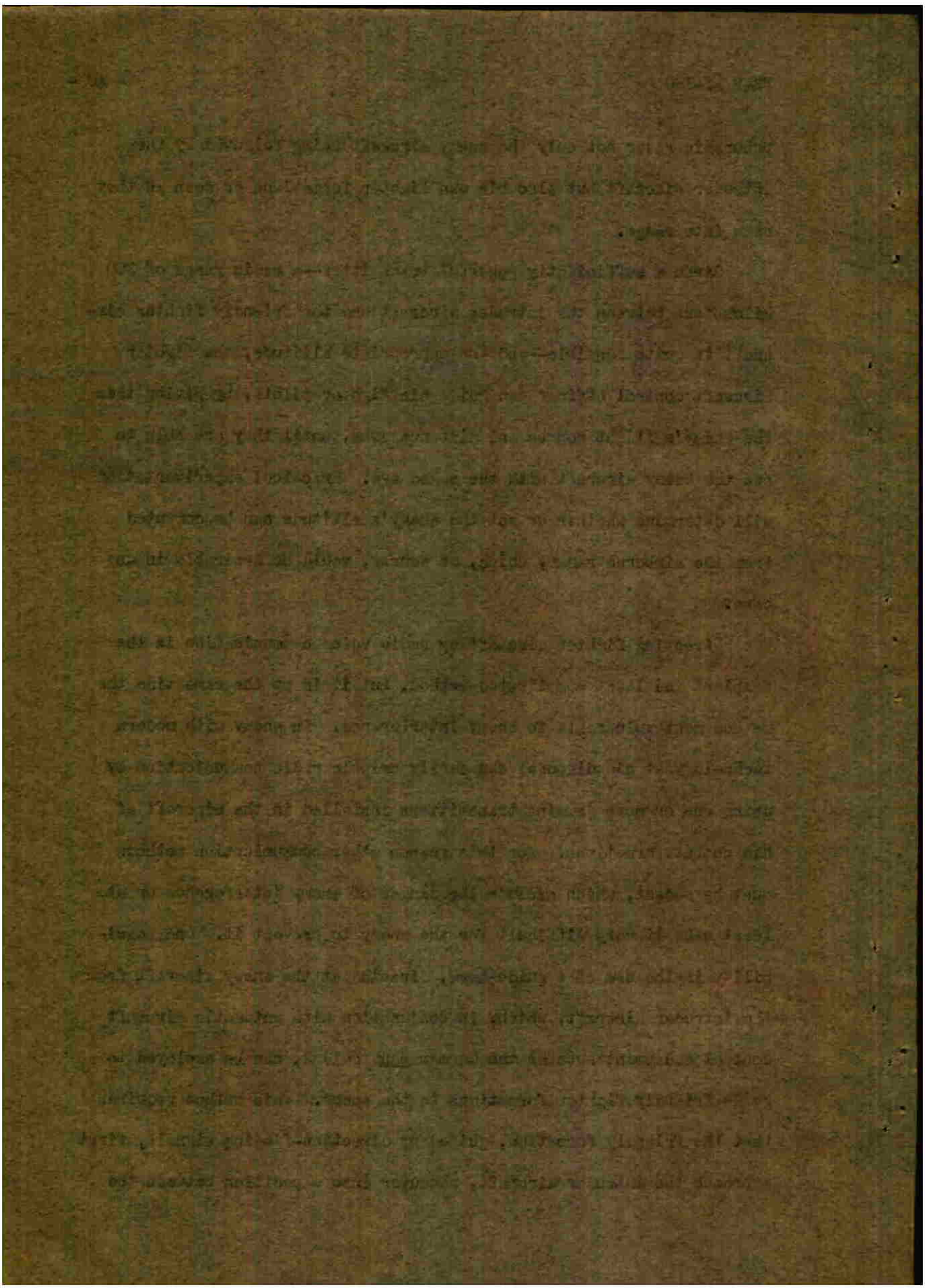
The fighter aircraft control officer stationed in the intruder aircraft can direct the fighter aircraft directly to the enemy by radio voice communication, for he can observe on the screen of his



panoramic radar not only the enemy aircraft being followed by the intruder aircraft but also his own fighter formations as soon as they come into range.

Given a sufficiently powerful transmitter—a radio range of 300 kilometers between the intruder aircraft and the friendly fighter aircraft is quite possible—and the appropriate altitude, the fighter aircraft control officer can guide his fighter pilots, by giving them the enemy's flight course and distance away, until they are able to see the enemy aircraft with the naked eye. Practical experimentation will determine whether or not the enemy's altitude can be computed from the airborne radar, which, of course, would be desirable in any case.

Directing fighter aircraft by radio voice communication is the simplest and least complicated method, but it is at the same time the method most vulnerable to enemy interference. An enemy with modern technology at his disposal can easily cripple radio communication by using one or more jamming transmitters installed in the aircraft of his combat formations. For this reason other communication methods must be sought, which exclude the danger of enemy interference or at least make it very difficult for the enemy to prevent it. One possibility is the use of a guide beam, directed at the enemy aircraft from the intruder aircraft, which, in conjunction with automatic aircraft control equipment such as the German Uhu (owl) 2, can be employed to guide friendly fighter formations to the enemy. This method requires that the friendly formation, guided by direction-finding signals, first approach the intruder aircraft, maneuver into a position between the



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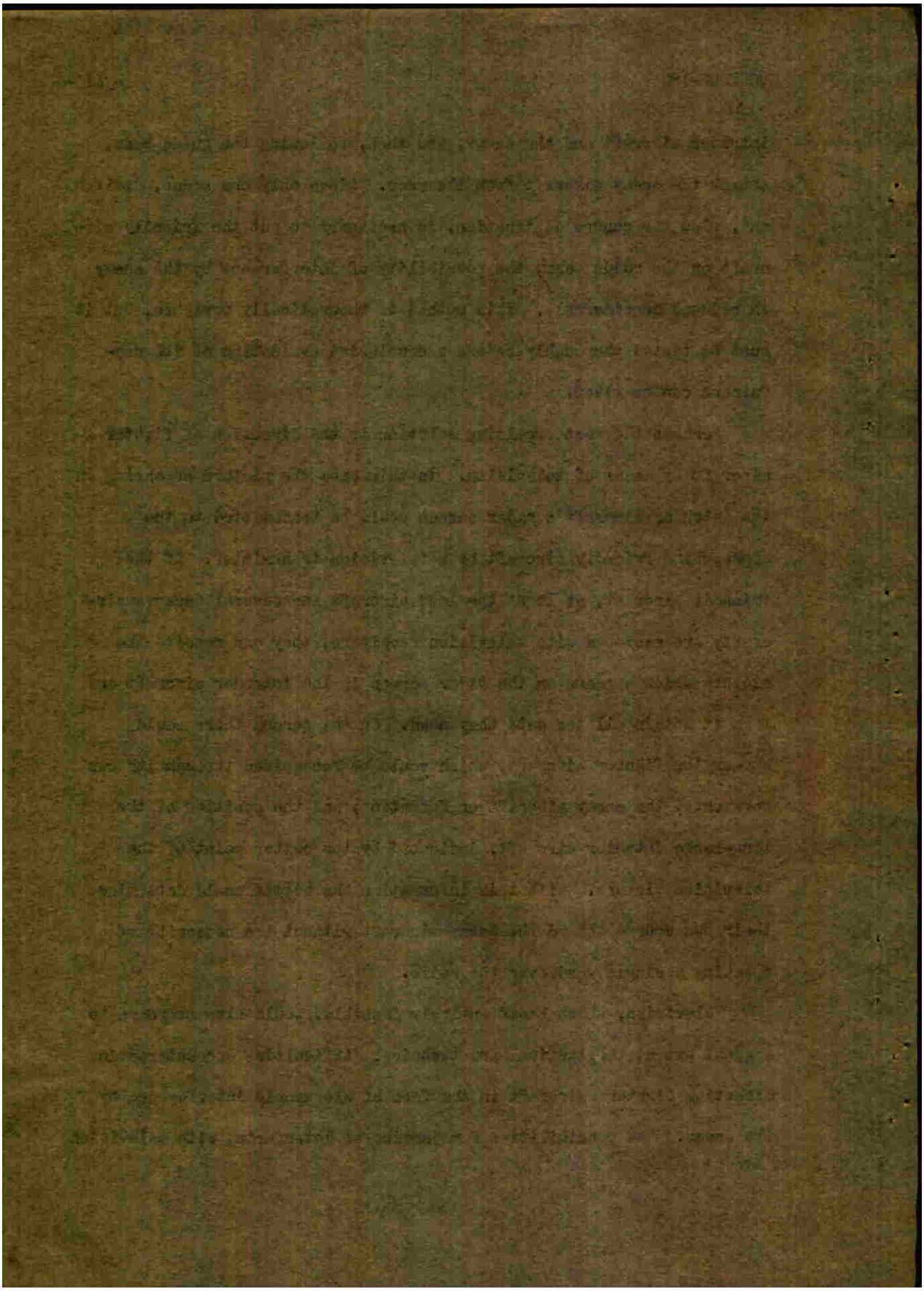
intruder aircraft and the enemy, and then, following the guide beam, attack the enemy aircraft from the rear. Since only one order, "switch on", plus the course designation, is necessary to put the friendly aircraft on the guide beam, the possibility of interference by the enemy is reduced considerably. This method is theoretically workable, but it must be tested thoroughly before a conclusive evaluation of its usefulness can be given.

Perhaps the most promising solution is the direction of fighter aircraft by means of television. In this case the picture appearing on the intruder aircraft's radar screen could be transmitted to the approaching friendly aircraft by a television transmitter. If the friendly aircraft, at least the lead aircraft and several reserve aircraft, are equipped with television receivers, they can receive the picture which appears on the radar screen in the intruder aircraft and from it obtain all the data they need. On the screen there would appear the fighter aircraft, which could be recognized through its own movements, the enemy aircraft or formation, and the position of the long-range intruder aircraft, indicated by the center point of the television picture. With this information the pilots could determine their own course toward the enemy aircraft without the necessity of speaking a single word over the radio.

Television, which seems entirely feasible, would also overcome to a great extent the tactical and technical difficulties encountered in directing fighter aircraft in the face of electronic interference by the enemy. The possibilities for jamming or interfering with television



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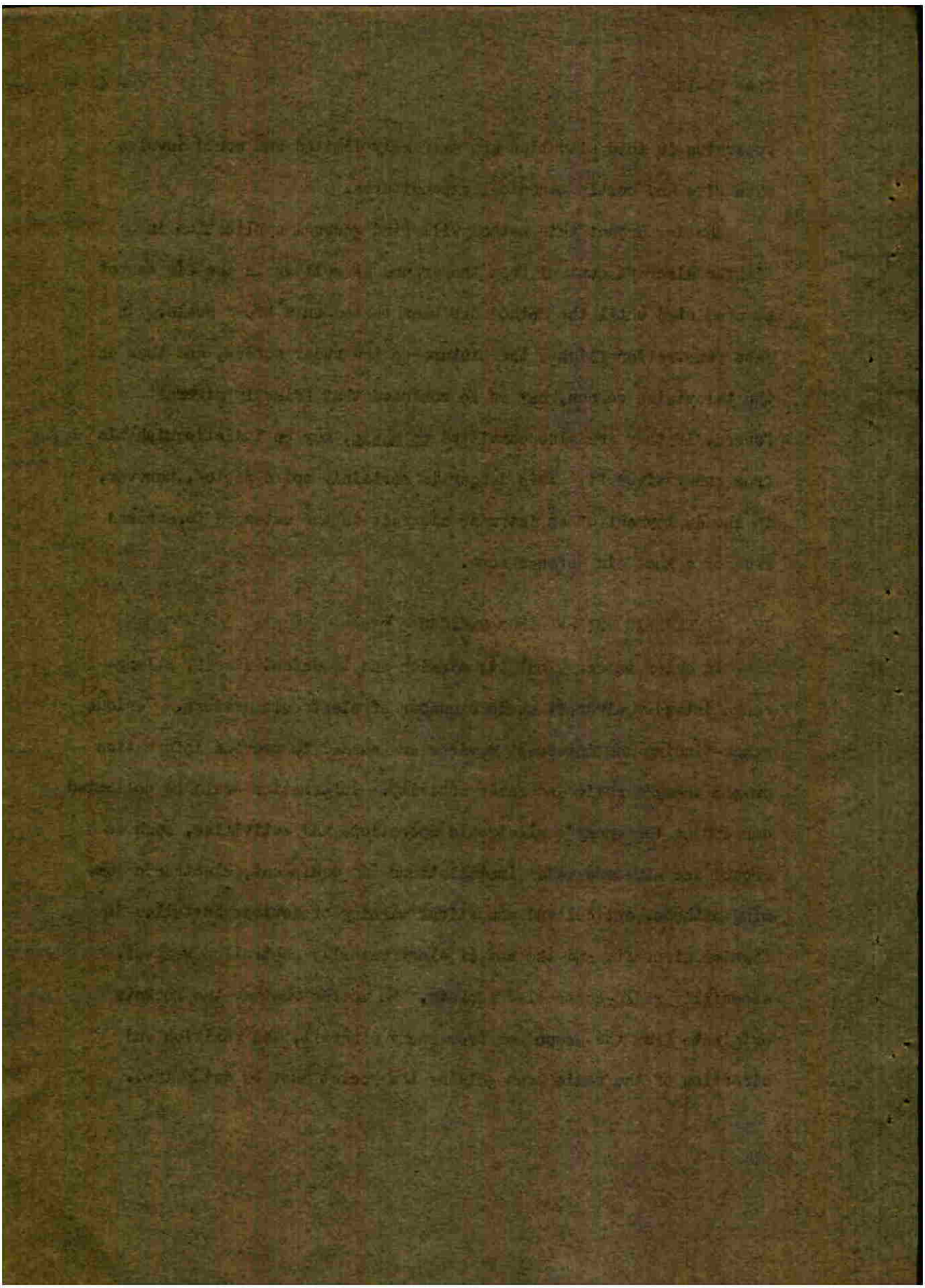
apparatus in this situation are extremely limited and would involve excessive and costly technical expenditures.

Whether or not this method will find general application in fighter aircraft control from the ground as well as in the air cannot be predicted until the method has been tested on a broad scale. In mass penetration flights the picture on the radar screen, and thus on the television screen, may be so confused that friendly aircraft forces, if they are also committed en masse, may be indistinguishable from enemy aircraft. This danger is certainly not a factor, however, in the employment of an intruder aircraft in the extended foreground area of a home air defense zone.

IV. ELECTRONIC INTERFERENCE DEVICES

In order to carry out its mission and to defend itself, a long-range intruder aircraft needs a number of electronic devices. Various range-finding and intercept devices are needed to provide information on the enemy's radio and radar activity. Information would be collected concerning the enemy's electronic operations and activities, such as ground and airborne radar installations and equipment, electronic jamming methods, optical and acoustical warning of devices installed in fighter aircraft, and the use of electronically controlled weapons, especially radio-controlled rockets. No matter whether the rockets originate from the ground or from enemy aircraft, the position and direction of the radio beam guiding the rocket must be determined.



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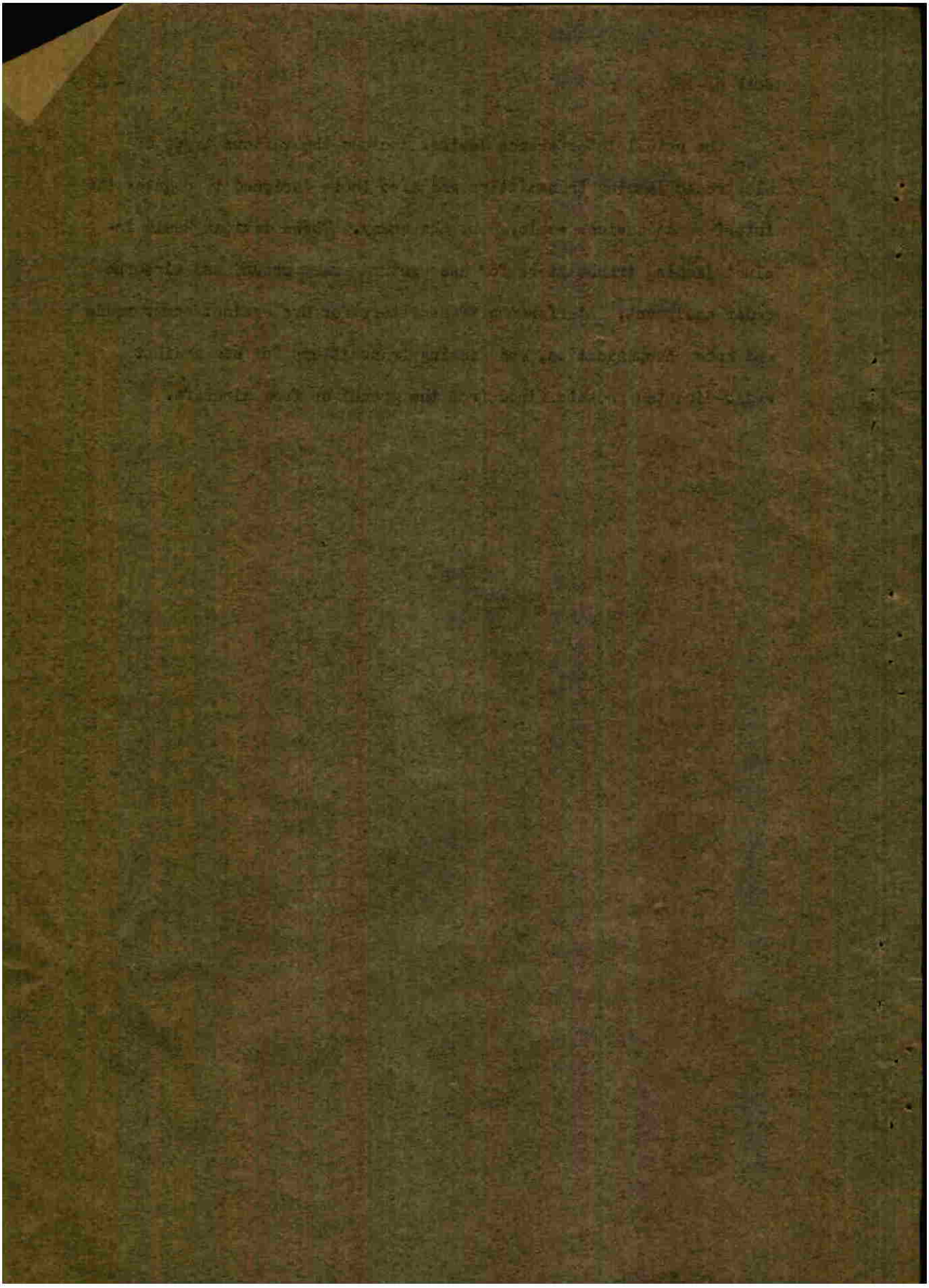
The actual interference devices include the various types of electronic jamming transmitters and also those designed to counter the interference devices employed by the enemy. These devices would include jamming transmitters for use against enemy ground and airborne radar equipment, interference transmitters for use against enemy radio and radar communication, and jamming transmitters for use against radio-directed rockets fired from the ground or from aircraft.



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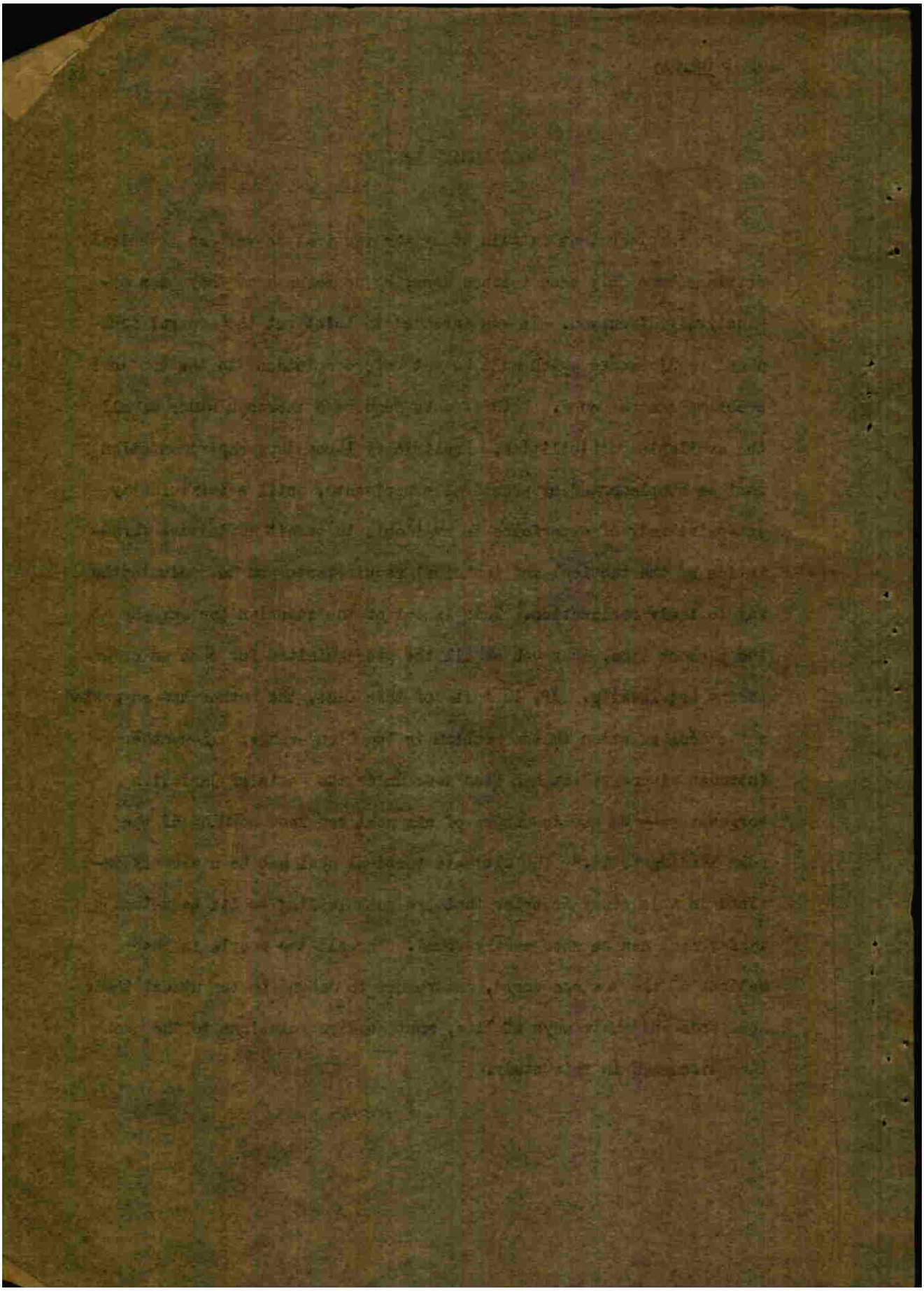
CONCLUDING REMARKS

It is clear that in this study the tactical as well as technical problems have only been touched upon; by no means have they been exhaustively discussed. It was intended to point out the general technical requirements which must be met before solutions to the tactical problems can be found. Both aspects require a thorough study of all the available possibilities. Preliminary laboratory experimentation must be supplemented by practical experiments, until a sufficiently extensive body of experience is available to permit definitive formulation of the tactical and technical requirements and to indicate the way to their realization. This is out of the question for Germany at the present time, inasmuch as all the prerequisites for such an undertaking are lacking. If, in spite of this fact, the author has suggested a tactical solution to the problem in the "long-range, all-weather intruder aircraft," it has been done under the aegis of Christian Morgenstern—"He who is unsure of his goal can know nothing of the road leading to it." The ultimate tactical goal has been clearly defined in this study in order that the path leading to its technical achievement can be more easily found. For all the people in the nations of the Western World, determined to defend to the utmost their homelands and their ways of life, must acquire solutions to the problems discussed in this study.



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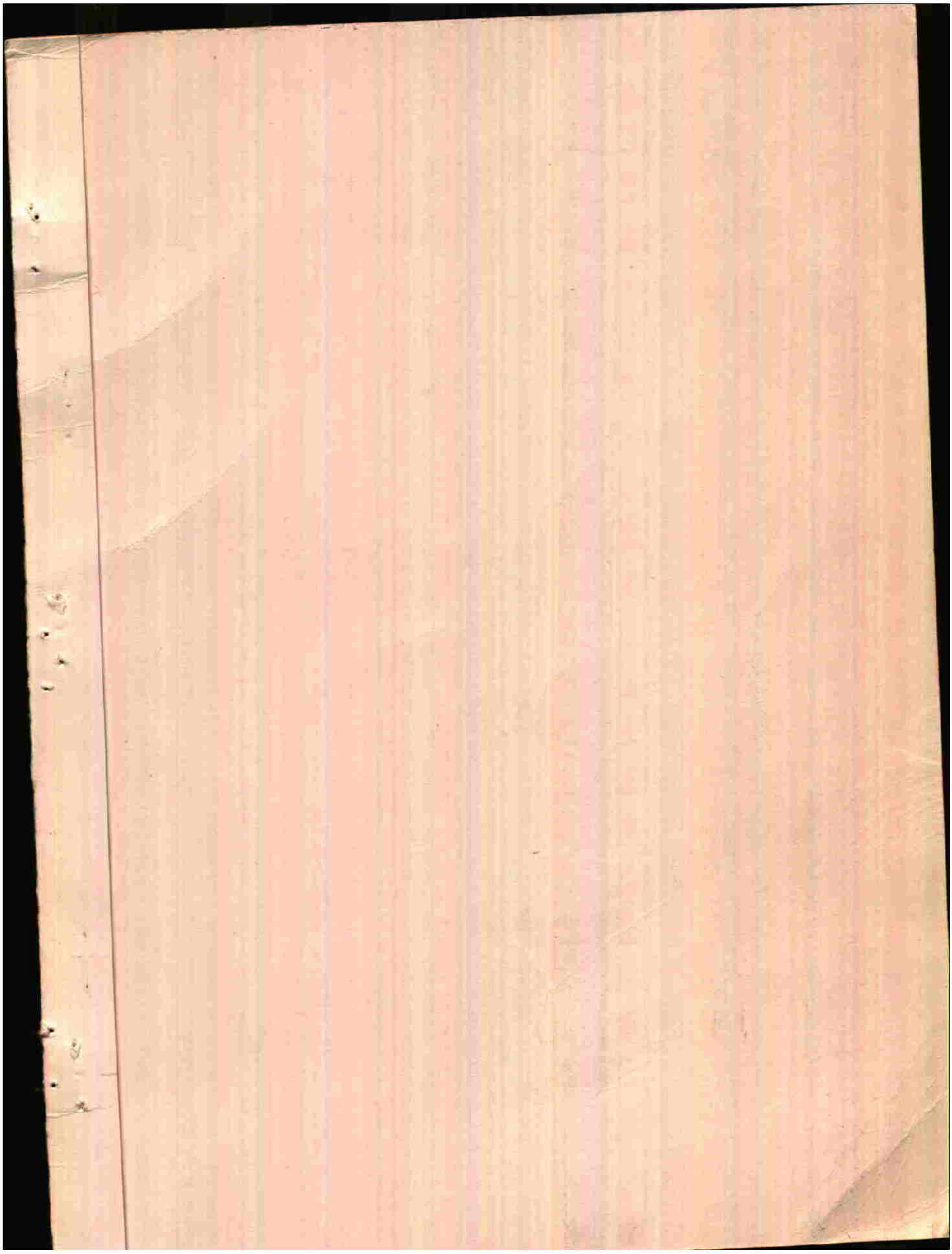

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